2015 Integrated Resource Plan

November 30, 2015

Appendices A–O

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2015 PSE Integrated Resource Plan

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PUBLIC PARTICIPATION

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PSE is committed to public involvement in the planning process. Stakeholder meetings generated valuable constructive feedback, and the suggestions and practical information we received from both organizations and individuals helped guide the development of the 2015 IRP. We wish to thank all who participated.

OVERVIEW

By the time this plan was filed with the Washington Utilities and Transportation Commission (WUTC), 13 formal Integrated Resource Plan Advisory Group (IRPAG) meetings had been held, as well as numerous Conservation Resource Advisory Group (CRAG) and Technical Advisory Group (TAG) meetings and dozens of informal meetings and communications. Stakeholders who actively participated in one or more meetings include Washington Utilities and Transportation Commission (WUTC) staff, Public Counsel, Northwest Industrial Gas Users (NWIGU), Northwest Gas Association (NWGA), Northwest Pipeline, conservation and renewable resource advocates, the Northwest Power and Conservation Council, project developers, other utilities, customers, the City of Bellevue and the Washington State Department of Commerce.

This appendix briefly describes the purpose of the IRPAG, CRAG and TAG, and lists the formal IRPAG meetings held. We especially want to thank those who attended these meetings for both the time and energy they invested, and we encourage their continued participation. The IRPAG covers all elements of the IRP, the CRAG focuses on energy efficiency and demand-side resources and the TAG delves into detailed technical information. While the three groups meet separately, they have many members in common.

INTEGRATED RESOURCE PLANNING ADVISORY GROUP (IRPAG)

Throughout the development of the IRP, PSE works with external stakeholders via an informal group called the IRPAG. WAC 480-90/100-238 requires PSE to develop the IRP and implement the two-year action plan it recommends; the IRPAG is the primary means of satisfying the public involvement requirements of the law. While the IRP document is not a product of "consensus," the IRPAG engages PSE and stakeholders in a consultative process that has proven to be an effective means for PSE planning staff to receive input on many key framework assumptions and related issues.

One of the Action Plan items presented in Chapter 1, Executive Summary, of the 2013 IRP was to "develop a robust work plan for the 2015 IRP to clarify the roles and expectations of the public participation process and to provide greater transparency regarding PSE's analytical processes." In this regard, PSE retained PDSA Consulting, Inc. to facilitate both the IRPAG and CRAG meetings, setting up consensus-driven ground rules for the 2015 IRPAG process. The ground rules provided various meeting guidelines, the documentation of meeting notes, a listing of next steps and action items, timing of IRPAG presentation material distribution and the creation of Technical Advisory Groups (TAG) to address complex analytical issues to be shared with the IRPAG.

IRPAG Meetings for the 2015 IRP

The agendas, meeting notes, handouts and copies of the full presentations made by PSE staff at the IRP Advisory Group meetings are posted on PSE's website at http://pse.com/aboutpse/EnergySupply/Pages/Resource-Planning.aspx.

March 18, 2014 (kickoff)
May 16, 2014
July 28, 2014
September 25, 2014
December 8, 2014

January 22, 2015
March 20, 2015
April 9, 2015
May 19, 2015
June 18, 2015
August 3, 2015
September 11, 2015
October 16, 2015

CONSERVATION RESOURCES ADVISORY GROUP (CRAG)

The CRAG was formally established as part of the settlement of PSE's 2001 General Rate Case, which the WUTC approved in Docket Nos. UE-011570 and UG-011571. The group specifically works with PSE on development of energy efficiency plans, targets and budgets. The CRAG consists of ratepayer representatives, regulators and energy efficiency policy organizations.

The CRAG participated in the development of the 2015 IRP and energy efficiency program review through formal meetings in which it reviewed and offered feedback on the assessment of all demand-side resources (energy efficiency, fuel conversion and demand-response). The CRAG is also instrumental in reviewing IRP guidance to develop PSE’s biennial energy efficiency targets and programs, and in reviewing our progress toward achieving those targets. Many members participated in other aspects of the IRP advisory process as well.

TECHNICAL ADVISORY GROUP (TAG)

The IRPAG created the TAG at the start of this 2015 IRP process to address the 2013 IRP Action Plan goal of providing greater transparency regarding PSE's analytical processes. The TAG is a smaller group of technical people who agreed to address and understand technical information in order to educate and provide feedback to the IRPAG in an efficient and effective manner. The TAG met multiple times during the course of the 2015 IRP process and researched and provided guidance on a number of issues.

LEGAL REQUIREMENTS AND OTHER REPORTS

Contents

PSE is submitting this IRP pursuant to state regulations regarding electric and natural gas utility resource planning contained in WAC 480-100-238 and WAC 480-90-238, respectively. Section 1 of this appendix outlines the regulatory requirements for electric and gas integrated resource plans and identifies where each of these requirements is addressed within the IRP. Section 2 reports on the electric and gas utility action plans put forward in the previous IRP. Section 3 offers two additional reports. The first illustrates how PSE's electric demand-side resources assessment is consistent with the Northwest Power and Conservation Council's methodology. The second summarizes the load-resource balance information presented in this IRP.

This IRP is the product of robust analysis that considered a wide range of future risks and uncertainties. PSE believes this plan meets applicable statutory requirements, and seeks a letter from the WUTC accepting this filing.

REGULATORY REQUIREMENTS

Figures B-1 and B-2 delineate the regulatory requirements for electric and natural gas integrated resource plans and identify the chapters of this plan that address each requirement.

Figure B-1: Electric Utility Integrated Resource Plan Regulatory Requirements

Statutory or Regulatory Requirement	Chapter and/or Appendix
WAC 480-100-238 (3) (a) A range of forecasts of future demand using methods that examine the effect of economic forces on the consumption of electricity and that address changes in the number, type and efficiency of electrical end-uses.	Chapter 4, Key Analytical Assumptions Chapter 5, Demand Forecasts Appendix E, Demand Forecasting Models
WAC 480-100-238 (3) (b) An assessment of commercially available conservation, including load management, as well as an assessment of currently employed and new policies and programs needed to obtain the conservation improvements.	Chapter 6, Electric Analysis Appendix J, Demand-side Resources
WAC 480-100-238 (3) (c) An assessment of a wide range of conventional and commercially available nonconventional generating technologies.	Chapter 6, Electric Analysis Appendix D, Electric Resources and Alternatives Appendix K, Colstrip Appendix L, Electric Energy Storage Appendix M, Distributed Solar
WAC 480-100-238 (3) (d) An assessment of transmission system capability and reliability, to the extent such information can be provided consistent with applicable laws.	Appendix I, Regional Transmission Resources
WAC 480-100-238 (3) (e) A comparative evaluation of energy supply resources (including transmission and distribution) and improvements in conservation using the criteria specified in WAC 480-100-238 (2) (b), Lowest reasonable cost.	Chapter 2, Resource Plan Decisions Chapter 6, Electric Analysis Appendix I, Regional Transmission Resources Appendix N, Electric Analysis Appendix J, Demand-side Resources
WAC 480-100-238 (3) (f) Integration of the demand forecasts and resource evaluations into a long-range (e.g., at least ten years; longer if appropriate to the life of the resources considered) integrated resource plan describing the mix of resources that is designated to meet current and projected future needs at the lowest reasonable cost to the utility and its ratepayers.	Chapter 2, Resource Plan Decisions
WAC 480-100-238 (3) (g) A short-term plan outlining the specific actions to be taken by the utility in implementing the long-range integrated resource plan during the two years following submission.	Chapter 1, Executive Summary

Statutory or Regulatory Requirement	Chapter and/or Appendix
WAC 480-100-238 (3) (h) A report on the utility's progress towards implementing the recommendations contained in its previously filed plan.	Appendix B, Legal Requirements and Other Reports
WAC 480-100-238 (4) Timing. Unless otherwise ordered by the commission, each electric utility must submit a plan within two years after the date on which the previous plan was filed with the commission. Not later than twelve months prior to the due date of a plan, the utility must provide a work plan for informal commission review. The work plan must outline the content of the integrated resource plan to be developed by the utility and the method for assessing potential resources.	2015 Integrated Resource Plan Work Plan filed with the WUTC May 29, 2014, and Updated Work Plan filed July 31, 2015
WAC 480-100-238 (5) Public participation. Consultations with commission staff and public participation are essential to the development of an effective plan. The work plan must outline the timing and extent of public participation. In addition, the commission will hear comment on the plan at a public hearing scheduled after the utility submits its plan for commission review.	Appendix A, Public Participation
RCW 19.280.030 (e) An assessment of methods, commercially available technologies, or facilities for integrating renewable resources, and addressing overgeneration events, if applicable to the utility's resource portfolio.	Appendix H, Operational Flexibility Overgeneration events are not applicable to PSE.

Figure B-2: Natural Gas Utility Integrated Resource Plan Regulatory Requirements

Statutory or Regulatory Requirement	Chapter and/or Appendix
WAC 480-90-238 (3) (a) A range of forecasts of future natural gas demand in firm and interruptible markets for each customer class that examine the effect of economic forces on the consumption of natural gas and that address changes in the number, type and efficiency of natural gas end-uses.	Chapter 4, Key Analytical Assumptions Chapter 5, Demand Forecasts Appendix E, Demand Forecasting Models
WAC 480-90-238 (3) (b) An assessment of commercially available conservation, including load management, as well as an assessment of currently employed and new policies and programs needed to obtain the conservation improvements.	Chapter 7, Gas Analysis Appendix J, Demand-side Resources
WAC 480-90-238 (3) (c) An assessment of conventional and commercially available nonconventional gas supplies.	Chapter 7, Gas Analysis

Statutory or Regulatory Requirement	Chapter and/or Appendix
WAC 480-90-238 (3) (d) An assessment of opportunities for using company-owned or contracted storage.	Chapter 7, Gas Analysis Appendix O, Gas Analysis
WAC 480-90-238 (3) (e) An assessment of pipeline transmission capability and reliability and opportunities for additional pipeline transmission resources.	Chapter 7, Gas Analysis Appendix O, Gas Analysis
WAC 480-90-238 (3) (f) A comparative evaluation of the cost of natural gas purchasing strategies, storage options, delivery resources, and improvements in conservation using a consistent method to calculate cost-effectiveness.	Chapter 7, Gas Analysis Appendix O, Gas Analysis Appendix J, Demand-side Resources
WAC 480-90-238 (3) (g) The integration of the demand forecasts and resource evaluations into a long-range (e.g., at least ten years; longer if appropriate to the life of the resources considered) integrated resource plan describing the mix of resources that is designated to meet current and future needs at the lowest reasonable cost to the utility and its ratepayers.	Chapter 2, Resource Plan Decisions
WAC 480-90-238 (3) (h) A short-term plan outlining the specific actions to be taken by the utility in implementing the long-range integrated resource plan during the two years following submission.	Chapter 1, Executive Summary
WAC 480-90-238 (3) (i) A report on the utility's progress towards implementing the recommendations contained in its previously filed plan.	Appendix B, Legal Requirements and Other Reports
WAC 480-90-238 (4) Timing. Unless otherwise ordered by the commission, each natural gas utility must submit a plan within two years after the date on which the previous plan was filed with the commission. Not later than twelve months prior to the due date of a plan, the utility must provide a work plan for informal commission review. The work plan must outline the content of the integrated resource plan to be developed by the utility and the method for assessing potential resources.	2015 Integrated Resource Plan Work Plan filed with the WUTC May 29, 2014, and Updated Work Plan filed July 31, 2015
WAC 480-90-238 (5) Public participation. Consultations with commission staff and public participation are essential to the development of an effective plan. The work plan must outline the timing and extent of public participation. In addition, the commission will hear comment on the plan at a public hearing scheduled after the utility submits its plan for commission review.	Appendix A, Public Participation

REPORT ON PREVIOUS ACTION PLANS

2013 Electric Resources Action Plan

Per WAC 480-100-238 (3) (h), each item from the 2013 IRP electric resources action plan is listed below, along with the progress that has been made in implementing those recommendations.

Electric Demand-side Resources. Pursue cost-effective demand-side resources based on IRP guidance. Work with external stakeholders in the CRAG process to establish targets and tariff filings, using this IRP as a starting point. Issue Request for Proposals (RFPs) as appropriate to assist with efficient acquisition of demand-side resources.

PROGRESS

PSE reviewed the 2013 IRP guidance with its Conservation Resource Advisory Group (CRAG) beginning in June 2013. Over the course of the following four months, PSE collaborated with the CRAG to develop its 2014-2015 EIA electric demand-side resource target, which was approved by the Commission on December 19, 2013. PSE issued an “all-comers” Request for Information for possible new energy efficiency programs on or about March 15, 2013. An additional RFP for existing and two new programs was issued in August 2013.

PSE ensures that the CRAG is engaged in its program development by conducting regular CRAG meetings and providing the CRAG with routine updates in its “CRAG Communications” newsletters. Please see Appendix A, Public Participation, for further information regarding the CRAG.

Reduce Market Reliance. Develop a strategy to reduce reliance on market in the intermediate to long-term, including coordination with others in the region as appropriate. File an update or addendum to the 2013 IRP early in the fourth quarter of 2013 to address concerns about relying on market to meet capacity needs.

PROGRESS

PSE filed an Update to the 2013 IRP on December 31, 2013. The 2013 IRP Update noted that at that time, relying on 1,600 megawatts (MW) of short-term wholesale market capacity to meet peak electric need was reasonable because the region was surplus, and generation to back-fill coal plant retirements could be built with a three-year lead time. PSE also noted that it would continue to monitor and evaluate the issue. Detailed discussion of these examinations can be found in the 2015 IRP in Appendix G, Wholesale Market Risk, and Chapter 6, Electric Analysis.

Resource Acquisition Timeline. Ensure that the timeline for resource acquisitions is long enough to accommodate the type of infrastructure development that may be required due to anticipated changes in regional resource adequacy.

PROGRESS

Since energy efficiency and demand-response additions appear sufficient to meet incremental capacity need until 2021 and satisfy WAC 480-107 requirements, it makes sense to wait for further PSE demand and regional resource adequacy studies before issuing a Request for Proposals (RFP). PSE anticipates that when an RFP is issued it will be ahead of the three-year window that would require an RFP based on WAC 480-107-015(3). This should allow adequate time to develop the appropriate infrastructure that may be required. A step-by-step description of PSE's RFP process is included in the Electric Resource Acquisition section of Chapter 3, Planning Environment.

Gas Storage for Electric Generation. Pursue the prudent acquisition of gas storage for generation.

PROGRESS

PSE is in the process of negotiating for the acquisition of firm storage for power generating assets along with related firm transportation, and we expect to complete one or more transactions before the end of 2015.

Improve IRP Process. Develop a robust work plan for the 2015 IRP to clarify the roles and expectations of the public participation process and to provide greater transparency regarding PSE's analytical processes.

PROGRESS

On May 29, 2014, PSE filed a Work Plan for the 2015 Integrated Resource Plan which included a timeline, a summary for assessing resources and an outline of the 2015 IRP content. Throughout the 2015 IRP process, PSE posted meeting notes, handouts and presentations from the IRP Advisory Group (IRPAG) meetings on its website. Please refer to PSE's website for a copy of its 2015 IRP Work Plan and IRPAG information: http://pse.com/aboutpse/EnergySupply/Pages/Resource-Planning.aspx.

2013 Gas Resources Action Plan

Per WAC 480-90-238 (3) (i), each item from the 2013 IRP gas resources action plan is listed below, along with the progress that has been made in implementing those recommendations.

Gas Demand-side Resources. Pursue cost-effective demand-side resources based on IRP guidance. Work with external stakeholders in the CRAG process to establish goals, targets and tariff filings, using this IRP as a starting point. Issue RFPs as appropriate to assist with efficient acquisition of demand-side resources.

PROGRESS

PSE reviewed the 2013 IRP guidance with its CRAG beginning in June 2013. Over the course of the following four months, PSE collaborated with the CRAG to develop its 2014-2015 natural gas goal, which was approved by the Commission on December 19, 2013. PSE issued an "all-comers" Request for Information for possible new energy efficiency programs on or about March 15, 2013. An additional RFP for existing and two new programs was issued in August 2013.

PSE ensures that the CRAG is engaged in its program development by conducting regular CRAG meetings and providing the CRAG with routine updates in its "CRAG Communications" newsletters.

PSE LNG Project. Continue working toward developing the potential PSE LNG Project to support gas utility peaking and transportation sector needs. Update and refine cost/resource estimates on expanding the facility's potential to provide peaking capabilities for the gas utility portfolio as the project proceeds.

PROGRESS

PSE is in the development phase of the PSE LNG project in Tacoma. A major transportation sector customer has executed long-term agreements. PSE expects to have the project in service by late 2018. Please see Chapter 7, Gas Analysis, for additional information.

Swarr. Further analyze the costs and resource issues associated with investing in the Swarr facility to restore its original 30 MDth per day capability. Decide whether such investments will provide a safe, cost-effective resource for meeting the needs of customers.

PROGRESS

PSE has designed and scheduled an upgrade project that will restore the Swarr facility to safe, reliable service by the fourth quarter of 2016.

Pipeline Expansions. Continue working with Northwest Natural Gas and Northwest Pipeline (NWP) on the possibility of participating in an expansion of the Mist storage facility and transportation to PSE's service territory.

PROGRESS

PSE has continued dialogue with these and other parties in the region. It has become clear that acquisition of cost-effective firm pipeline capacity from Mist to the PSE gas service area or power plant sites (north-bound) is dependent on the expansion of NWP facilities in the south-bound direction. Such expansion would only be triggered by firm commitments to NWP by other large new customers. PSE is also aware that once an expansion is triggered, other options, including peak-period gas diversions from new customers, may be possible and will be considered. Please see Chapter 7, Gas Analysis, for additional information.

Pipeline Capacity Acquisition. Remain active in the market to ensure PSE can acquire existing surplus firm pipeline capacity in case the PSE LNG Peaking Project or Swarr opportunities do not move forward.

PROGRESS

PSE continues to monitor the market to be aware of any opportunities for both short- and long-term pipeline capacity.

Gas Planning Analytics. Complete analysis of whether the gas planning standard should include additional aspects, such as sustained peaking or cold snap metrics.

PROGRESS

PSE used the peak day design temperature standard in this IRP – as it has in past IRPs. Also, included in this IRP is the impact on available pipeline transportation capacity under various extreme weather conditions. PSE continues to study the costs and benefits of using a sustained peaking metric and its impact on available gas supply-side resources including storage to serve gas sales customers.

Improve IRP Process. Develop a robust work plan for the 2015 IRP to clarify the roles and expectations of the public participation process and to provide greater transparency regarding PSE's analytical processes.

PROGRESS

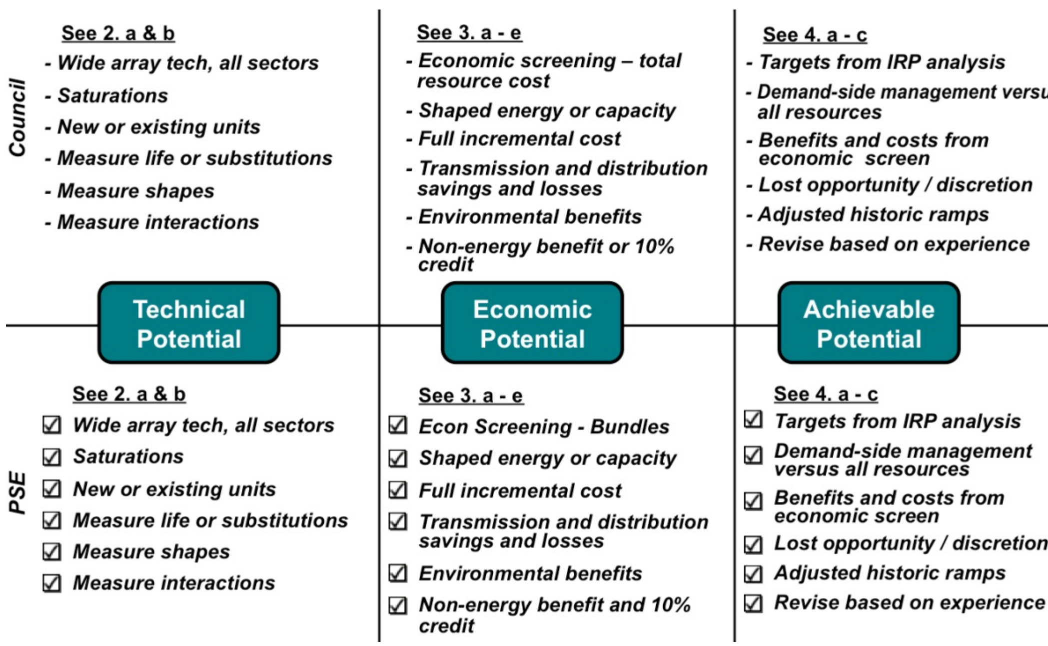
On May 29, 2014, PSE filed a Work Plan for the 2015 Integrated Resource Plan which included a timeline, a summary for assessing resources and an outline of the 2015 IRP content. Throughout the 2015 IRP process, PSE posted meeting notes, handouts and presentations from the IRP Advisory Group meetings on its website. Please refer to PSE's website for a copy of its 2015 IRP Work Plan and IRPAG information: http://pse.com/aboutpse/EnergySupply/Pages/Resource-Planning.aspx.

OTHER REPORTS

Electric Demand-side Resource Assessment: Consistency with Northwest Power and Conservation Council Methodology

There are no legal requirements for the IRP to address the Northwest Power and Conservation Council (Council) methodology for assessing demand-side resources. Such comparison, however, may be useful for PSE and stakeholders in implementing sections of WAC 480-109. PSE has worked closely with Council staff on several aspects of our analytical process, including approaches to modeling demand-side resources. We're most grateful for the dialogue, and very much appreciate the opportunity to work with Council staff. WAC 480-109 does not define "methodology." PSE developed the detailed checklist below to demonstrate that our IRP process is consistent with the Council's methodology.[1] This checklist was presented and discussed during the March 18, 2014 IRP Advisory Group meeting. Additional information on consistency with Council methodology can be found in the Cadmus report attached as Appendix J, Demand-side Resources.

Figure B-3: Comparison of Demand-side Resource Assessment Methodologies, PSE and the Northwest Power and Conservation Council



1 / References in Figure B-3 refer to the Council's assessment of its methodology, found at: http://www.nwcouncil.org/energy/powerplan/6/supplycurves/I937/default.htm

Department of Commerce
Integrated Resource Plan Cover Sheet

The WUTC is required to provide summary information about the IRPs of investor-owned utilities to the Department of Commerce. Information for the cover sheet is included in Figure B-4, below.

Figure B-4: Load-resource Balance Summary

Resource Plan Year:	2016
Base Year Start:	01/01/2016
Base Year End:	12/31/2016
Five-year Report Year:	2021
Ten-year Report Year:	2026

Report Years	***Base Year = 2016***			***2021***			***2026***		
Period	**Winter**	**Summer**	**Annual**	**Winter**	**Summer**	**Annual**	**Winter**	**Summer**	**Annual**
Units	**(MW)**	**(MW)**	**(aMW)**	**(MW)**	**(MW)**	**(aMW)**	**(MW)**	**(MW)**	**(aMW)**
Loads	4,929	3,170	2,636	5,364	3,577	2,888	5,784	3,989	3,136
Exports	34	334	69	20	320	59	0	300	47
Resources									
Conservation/Efficiency	75	28	27	411	245	275	669	431	470
Demand Response	18			121			130		
Cogeneration									
Hydro	897	781	521	897	777	516	897	777	500
Wind	74	74	251	74	74	251	74	74	251
Other Renewables									
Thermal - Gas	2,008	1,852	1,155	2,028	1,852	1,155	2,028	1,852	1,155
Thermal - Coal	592	592	575	592	592	575	592	592	575
Long Term: BPA Base Year or Tier 1									
Net Long Term Contracts: Other	492	300	358	405	395	408	15	4	5
Net Short Term Contracts	1,686	1,762		1,201	1,398		1,190	1,384	
Other									
Imports	308	8	50	308	8	47	308	8	47
Total Resources, net of Exports	6,115	5,061	2,868	6,016	5,020	3,169	5,903	4,822	2,957
Load Resource Balance (Surplus) / Deficit	(1,186)	(1,891)	(231)	(653)	(1,443)	(281)	(118)	(833)	179

ENVIRONMENTAL AND REGULATORY MATTERS

Contents

Climate and environmental impact policies continuously evolve at the state, regional and federal levels, and PSE is actively involved in these policymaking activities. This appendix summarizes the recent and evolving environmental rules and regulations that apply to PSE energy production activities.

ENVIRONMENTAL PROTECTION AGENCY REGULATIONS

Coal Combustion Residuals

On April 17, 2015, the United States Environmental Protection Agency (EPA) published a final rule, effective October 19, 2015, that regulates coal combustion residuals (CCRs) under the Resource Conservation and Recovery Act, Subtitle D. The CCR rule addresses the risks from coal ash disposal, such as leaking of contaminants into ground water, blowing of contaminants into the air as dust, and the catastrophic failure of coal ash containment structures by establishing technical design, operation and maintenance, closure and post-closure care requirements for CCR landfills and surface impoundments, and corrective action requirements for any related leakage. The rule also sets out recordkeeping and reporting requirements including posting specific information related to CCR surface impoundments and landfills to a publicly-accessible website. Using information from these public websites, enforcement of the CCR rule is left entirely to citizens' lawsuits – not EPA.

Mercury and Air Toxics Standard (MATS)

The EPA published the final Mercury and Air Toxics Standard in February 2012[1] to reduce air pollution from coal and oil-fired power plants with a capacity equal to or greater than 25 megawatts. The MATS rule establishes emissions limitations at coal-fired power plants for mercury (1.2 lbs per trillion British thermal units [TBtu]), and for acid gases and certain toxic heavy metals using a particulate matter surrogate (0.03 lb per million British thermal units [MMBtu]). Coal-fired generating units had until April 2015 to comply with MATS, and they could receive up to a 1-year extension from state permitting authorities for the installation of controls if necessary.[2]

On June 29, 2015, the United States Supreme Court held that the EPA failed to consider costs when deciding whether it was "appropriate and necessary" to regulate emissions of mercury and other hazardous air pollutants from power plants. The Supreme Court's decision overturned a 2014 ruling by the U.S. Court of Appeals for the District of Columbia Circuit ("D.C. Circuit"), which held that EPA's decision not to consider costs in the initial stages of the MATS rulemaking process was reasonable. The Supreme Court remanded the decision on MATS back to the D.C. Circuit for further proceedings, so the full impact is not yet known.

1/ The EPA issued the Final MATS rule April 30, 2015.
2 / Appendix K, Colstrip, describes Colstrip's compliance with the MATS rule.

The D.C. Circuit can either remand or vacate EPA's decision. Under a remand, the MATS rule would remain in effect while EPA addresses the deficiencies outlined by the Supreme Court. If the court vacated the rule, EPA would have to start the entire rulemaking process over again. EPA and environmental groups have already signaled their intent to argue for remand. The D.C. Circuit's decision is not expected for at least ten months, though industry petitioners may request expedited consideration.

Clean Water Act

Cooling Water Intake and Discharge. The EPA finalized the changes to Section 316(b) of the Clean Water Act that apply to power plant standards in May 2014. The rule requires power plants to install any one of a variety of technologies to reduce the amount of fish and other aquatic life killed by cooling water intake pipes. Environmental groups filed three separate challenges to the rule on September 2, 2014. They contend that the EPA gave utilities too much flexibility in finding a way to comply. On September 4, 2014, Entergy Corporation and the Utility Water Act Group, a coalition of 191 energy companies and three utility trade associations, filed a joint challenge on behalf of utility companies. This lawsuit is still pending before the Fourth Circuit Court of Appeals.

The rule's requirements address these potential impacts:

- Existing facilities with a design intake flow of greater than 2 million gallons per day, where more than 25 percent is used for cooling, are required to select from 9 compliance options related to impingement mortality.
- Existing facilities that withdraw at least 125 million gallons per day are required to monitor entrainment and assess the costs, benefits and other adverse environmental impacts of measures for reducing entrainment mortality. Based on these reports, the regulatory agency selects the best technology available for reducing entrainment mortality at a facility.
- New units that add electrical generation capacity at an existing facility are required to install technologies that reduce impingement and entrainment to a level equivalent to closed-cycle cooling.

Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category.

On September 30, 2015, the EPA finalized a rule to regulate wastewater discharges from power plants. The new rule sets limits on dissolved pollutants permitted in these discharges, and focuses on mercury, selenium, and arsenic (toxic metals previously unregulated in this context).

The finalized rule applies to all steam electric power plants, except for those smaller than 50 megawatts in production capacity, and oil-fired plants. Out of approximately 1,080 steam electric power plants in the U.S., 134 are expected to require new investments in order to comply with the regulations. The regulations will take effect in 2018, and compliance will be phased in through 2023.

Along with effluent limits on toxic metals and dissolved solids, the rule establishes zero discharge limits on pollutants in ash transport water and flue gas mercury control wastewater. Many units in the Pacific Northwest will be compliant with the rule provisions with their current controls, and therefore will not incur additional compliance costs. Colstrip is a Zero Liquid Discharge (ZLD) facility, so it will not be affected by the rule.

The Regional Haze Rule (Montana)

Adopted in 1998, the Regional Haze program is a 64-year program administered by the EPA under federal law to improve visibility. Specifically the rule is aimed at improving visibility in mandatory Class I areas (National Parks, National Forests and Wilderness Areas) and is not a health-based rule. The rule requires each state to prepare an analysis of visibility impairments to Class I areas and develop plans to eliminate man-made impairment by 2064. Major sources that began construction before 1977 (including Colstrip Units 1 & 2) must bring emission controls to Best Available Retrofit Technology (BART) standards during the initial review cycle. “Reasonable Progress” requirements call for an updated analysis of impacts every five years. It also requires states to constantly decrease haze in certain scenic areas of the country over time according to a “Glide Path.” Power plant emissions contributing to haze are evaluated in phases every 10 years and more stringent emission controls are required as needed to stay below the Glide Path.

The EPA published its Final Implementation Plan (FIP) for Colstrip, covering both the BART and Reasonable Progress requirements in September 2012, with implementation required within five years. The first phase of the Regional Haze program set emission limits for Colstrip 1 & 2 based on various emissions control technologies to bring the haze level below the Glide Path.

There were no immediate requirements for Colstrip Units 3 & 4, but Colstrip Units 1 & 2 were determined by EPA to need to upgrade pollution controls to meet new sulfur dioxide and nitrogen oxide limits. The Sierra Club filed an appeal of the FIP with the United States Court of Appeals for the Ninth Circuit on November 15, 2012, and Talen Energy also filed an appeal as the Colstrip operator. The case was heard on May 15, 2014 in Seattle, Wash., and the final decision by the Ninth Circuit was issued June 9, 2015.

On June 9, a three judge panel of the 9th Circuit Court of Appeals reviewed EPA's first phase requirements for Colstrip and found that the EPA had not adequately justified the need for two of the control technologies and remanded these two issues back to EPA for re-do. The ruling in no way affects the future planning periods for the Regional Haze program or the Glide Path. The current EPA assessment is that the state of Montana will require significant emission reductions to meet the natural visibility goal by 2064 which means that additional emission reductions will be necessary in future 10-year planning periods, beginning in the 2018-2028 period, and there is risk and uncertainty regarding potential costs.

For more information on the EPA FIP, see http://www2.epa.gov/sites/production/files/2014-02/documents/epafinalactononmontanaregionahazeplan.pdf.

For the draft Federal Implementation Plan containing EPA's analyses and cost estimates, see https://federalregister.gov/a/2012-8367.

National Ambient Air Quality Standards (NAAQS)

The Clean Air Act establishes two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation and buildings. These ambient level standards apply uniformly throughout the states.

The Clean Air Act required EPA to set NAAQS for widespread pollutants from numerous and diverse sources considered harmful to public health and the environment. EPA has set NAAQS for six "criteria" pollutants; periodic review of the standards and the science on which they are based is required.

Each time the NAAQS are revised, the states must evaluate whether any parts of the state exceed the standard (these are “non-attainment” areas). If a state contains any non-attainment areas, it must propose a plan and schedule to reduce emissions in order to achieve attainment approval by the EPA. Currently the Colstrip area of Montana is in attainment for all criteria pollutants. Reductions in Colstrip emissions for sulfur dioxide ($SO_{2)}$, nitrogen dioxide ($NO_{X)}$ and particulate matter (PM) to meet the MATS Rule and the EPA FIP are expected to keep the area in attainment with any NAAQS revisions with no further actions required. (For more information, go to http://www.epa.gov/ttn/naaqs/criteria.html.)

Ozone NAAQS in Washington State. On November 26, 2014 EPA announced a proposal to tighten the primary and secondary ozone NAAQS. EPA proposes to strengthen the ozone NAAQS by reducing the allowable level of ozone from 75 parts per billion (ppb) to a range of 65 to 70 ppb, however, EPA is taking comment on levels for the health standard as low as 60 ppb. The public has 90 days to comment on the proposal, once it is published in the Federal Register. If EPA finalizes the rule, nonattainment designations will be set by October 1, 2017. Areas in non-attainment will have 3, 6 or 9 years to meet the new standard, depending on the level of severity. If EPA finalizes a new standard by October 2017, non-attainment designations will likely be based on the three-year monitoring records from the 2014-2016 ozone seasons.

It will be the state’s responsibility to develop a State Implementation Plan to meet the standards. PSE cannot predict the outcome of this matter.

Greenhouse Gas Emissions

Section 111(b) of the Clean Air Act. On January 8, 2014, the EPA issued a proposed New Source Performance Standard (NSPS) for the control of carbon dioxide (CO_2) from new power plants that burn fossil fuels under section 111(b) of the Clean Air Act. EPA first proposed a NSPS for emissions for CO_2 from new power plants in April 2012. However, after more than 2.5 million comments on the original proposal, EPA decided that a new approach was warranted and rescinded the April 2012 proposal. The EPA is proposing an emissions limit for coal-fired sources of 1,100 lb CO_2 per megawatt hour (MWh); limits for natural gas combined-cycle sources would be set at 1,000 to 1,100 lb CO_2 per MWh, depending on the size and type of unit. Under the January 8, 2014 proposal, the Agency concluded that carbon capture and storage (CCS) has been adequately demonstrated as a technology for controlling CO_2 emissions in full-scale commercial applications at coal-fired electrical generating units; however, it reached the opposite conclusion, that CCS is not adequately demonstrated, in the case of gas-fired generators. PSE submitted comments before the end of the comment period on May 9, 2014.

On August 3, 2015, EPA issued a final rule combining its New and Modified proposals into one rulemaking and making several changes. The final rule separates standards for new power plants fueled by natural gas and coal. New natural gas power plants can emit no more than 1,000 lbs of CO_2 per MWh, which is achievable with the latest combined-cycle technology. New coal power plants can emit no more than 1,400 lbs CO_2 per MWh, which is less stringent than the draft rule. This standard for coal plants would not specifically require carbon capture and storage (CCS), but CCS was reaffirmed by EPA as Best System of Emissions Reduction (BSER). These 111(b) standards are implemented by the states, but states to not have much flexibility to alter the standards set by EPA.

Section 111(d) of the Clean Air Act. On June 2, 2014, the EPA proposed draft guidelines under section 111(d) of the Clean Air Act for the control of CO_2 emissions from existing fossil fuel-fired power plants. EPA estimated the proposed guidelines, which set individual emissions targets for each state, will reduce total power sector carbon emissions 30 percent from 2005 levels by 2030. EPA is applying its "best system of emission reductions" (BSER) approach. To establish reduction targets, the EPA initially followed a four-step approach: (1) improve the heat rate of individual generating units, thereby reducing the amount of CO_2 produced per unit of electricity generated, (2) prioritize dispatch of existing (and new) natural gas combined-cycle generation over coal-fired generation, (3) account for increasing renewable generation and nuclear generation that is under construction or will have extended life, and (4) improve demand-side energy efficiency to reduce the amount of electricity generation required.

States were given the flexibility to choose the emissions reduction strategies best suited to their reduction requirements, and they can select technologies and techniques beyond those defined in BSER provided that emission reductions are verifiable and approved by EPA. Under the draft rule a state must achieve its state-specific interim goals by 2025 and its final goals by 2030. PSE filed comments on the rule on December 1, 2014, at the end of the comment period.

EPA issued a prepublication version of the final 111(d) rule on August 3, 2015 which included several changes, many of which were requested in PSE's comments. The final rule was published in the Federal Register on October 24, 2015. Specifically, EPA excluded energy efficiency from the building blocks, leaving just three building blocks (increased efficiency for coal plants, greater utilization of natural gas plants and increased renewable sources), and provided more flexibility on interim goals by phasing in the reduction of the second building block and giving states the option to set their own interim compliance glide path and pushing the start of compliance to 2022. EPA also adjusted the 2012 baseline to address hydroelectricity variability and provided specific CO_2 mass targets by year for each state.

States have broad flexibility to pick a rate-based or mass-based approach and can design compliance options and decide how to allocate credits and whether to allow trading. EPA also gave states of the option of seeking an additional time if necessary to formulate a state plan – states must submit something within one year but can request up to an additional two years for development of a state plan.

Based on the changes to the final rule, the final CO_2 goal for Montana became 26 percent more stringent and the final CO_2 goal for Washington became 35 percent less stringent. By 2030 Montana must reduce CO_2 emissions from coal plants from 20.5 million tons to 11.3 million tons, which is a 45 percent reduction in CO_2 emissions. How this will affect Colstrip cannot be determined until a state implementation plan for Montana is finalized and approved by the EPA.

STATE AND REGIONAL ACTIVITY

California Cap-and-trade Program

On December 16, 2010, the California Air Resources Board (CARB) adopted final rules to enact cap-and-trade provisions in accordance with California's Global Warming Solutions Act of 2006 (AB-32). The final rule defines the ground rules for participating in the cap-and-trade program, including enforcement and linkage to outside programs. The compliance obligations became binding on January 1, 2013.

AB 32 requires California to reduce greenhouse gas (GHG) emissions to 1990 levels by 2020. It directs power providers to account for emissions from in-state generation and imported electricity. The regulatory approach assigns the electricity importer as the "first deliverer" of imported electricity and thus the point of regulation. Cap-and-trade regulations distinguish between "specified" and "unspecified" sources of electricity. An unspecified source means electricity generation that cannot be matched to a particular generating facility; these sources are subject to the default emission factor of 0.428 MT of CO_2e per MWh. A specified source is a particular generating unit or facility for which electrical generation can be confidently tracked due to full or partial ownership or due to its identification in a power contract, including any California-eligible renewable resource or an asset-owning or asset-controlling supplier. Imports from specified sources are eligible for a source-specific emission factor. To be eligible for a source-specific emission factor, imported electricity must not only come from a specified source, but any renewable energy credits associated with the electricity must be retired and verified. Imported electricity can only be assigned an emission factor lower than the default emission factor if the electricity is directly delivered, meaning the facility has a first point of interconnection with a California balancing authority or the electricity is scheduled for delivery from the specified source into a California balancing authority via a continuous transmission path.

Washington State

In 2008, the Washington legislature recognized that climate changes posed serious threats to the economic wellbeing, public health, natural resources and the environment of the state. To limit the impacts of climate change, the legislature required that the state reduce its greenhouse gas emissions by setting limits on those emissions (RCW 70.235). The legislature also required the limits be reviewed and recommendations be made by the Department of Ecology (Ecology) using the most current global, national and regional climate science. The regulations that have been established pursuant to 70.235 to limit greenhouse gas emissions in the state are discussed in this section.

Greenhouse Gas Emissions Performance Standard. Washington state law RCW 80.80.060(4), the GHG Emissions Performance Standard (EPS), establishes a limit of 970 lbs of CO_2 emissions per MWh from new baseload generating resources, and it prohibits utilities from entering into long-term contracts of 5 years or more to acquire power from existing generating resources that exceed this standard. Contracts of less than 5 years are allowed.

This means that PSE is prohibited from building or purchasing baseload generation resources that exceed the emission performance standard. Investor-owned utilities like PSE may apply to the Washington State Utilities and Transportation Commission for exemptions based on certain reliability and cost criteria.

The law was amended in 2011. This amendment incorporated changes related to the negotiated shutdown of the TransAlta coal-fired power plant located near Centralia, Wash. The change allows TransAlta to enter into “coal transition power” contracts with Washington utilities. It exempts TransAlta and the coal transition power contracts from complying with the EPS until the dates the coal units are required to meet the EPS in 2020 (for Unit 1) and 2025 (for Unit 2).

Carbon Dioxide Mitigation Program. In 2004, the Washington state legislature passed Substitute House Bill 3141, later codified in RCW 80.70. The law requires fossil-fueled thermal power plants above 25 megawatts (MW) (net output of the electric generator) to provide mitigation for 20 percent of the CO_2 emissions it produces over a 30-year period. The mitigation requirement applies to all new power plants filing for a Site Certification Agreement or Notice of Construction after July 1, 2004. The mitigation requirement also applies to modifications of existing plants permitted by Washington’s Department of Ecology or a local air quality agency that will increase power production capacity by 25 MW or more, or increase CO_2 emissions by 15 percent or more.

If mitigation is triggered, compliance must be attained through any one or a combination of these methods:

1. Paying an "Independent Qualified Organization" to verify compliance,
2. Purchasing permanent, verifiable carbon credits, or
3. Using a self-directed mitigation program.

If the third option is chosen, the mitigation program must be identified within a plan submitted as part of the permit application. Payment to a qualified organization and the cost for a self-directed mitigation program are initially limited to an amount derived by multiplying the tons of CO_2 emissions to be mitigated by $1.60.

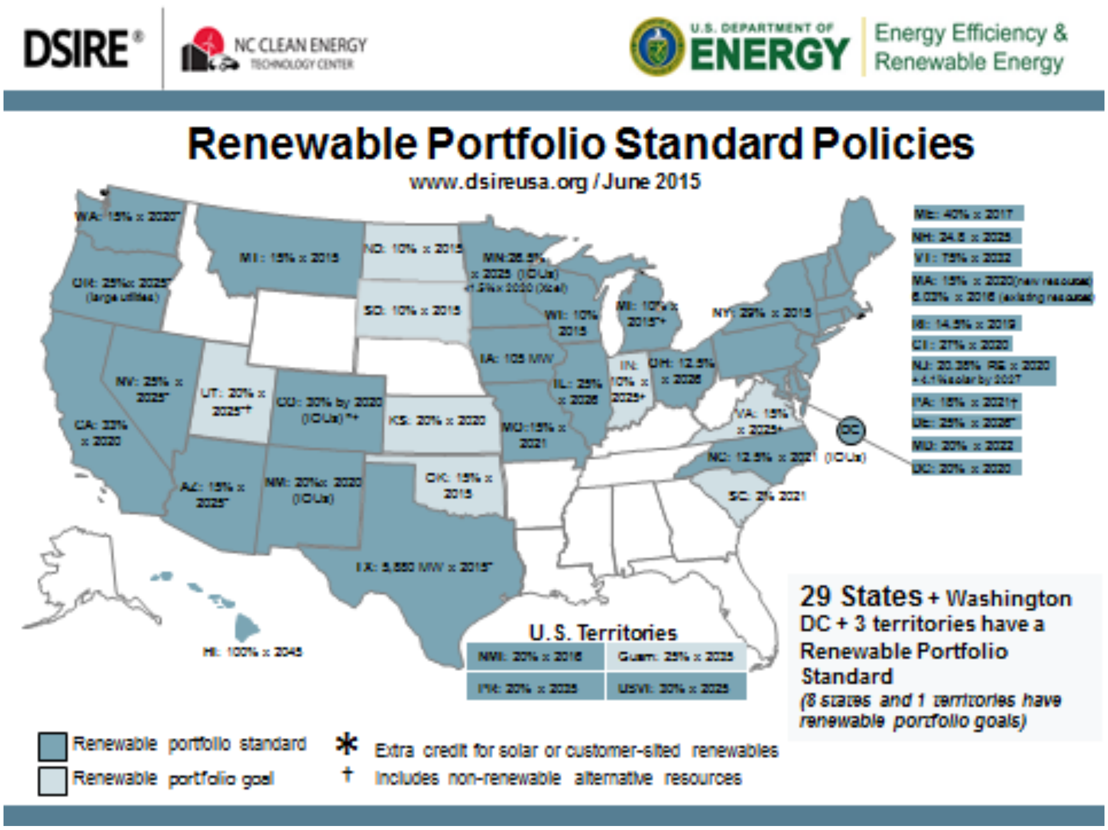
Washington Clean Air Rule. The Washington state Department of Ecology announced on September 21, 2015 a plan to promulgate a state rule to limit greenhouse gases from the state's 35 largest emitters. Ecology officials stated that the rule would apply to facilities emitting over 100,000 tons of greenhouse gases per year, would require reductions to reach 1990 greenhouse gas emissions by 2050, and would exclude the Centralia coal fired power plant. Remaining sources reporting over 100,000 tons per year include various gasoline and other fuel sources, industrial (includes refinery processing), local gas distribution companies, power plants and waste/landfills. The agency plans to work out details in the coming months and is soliciting stakeholder input. According to EPA a formal draft rule is expected by December 2015 a final draft rule by June 2016.

Renewable Portfolio Standards (RPS)

Renewable portfolio standards require utilities to obtain a specific portion of their electricity from renewable energy resources. Of the 11 Western interconnection states, 8 have binding renewable energy targets, one has a voluntary goal, and two have no RPS in place. PSE has met Washington's 2012 RPS requirement to meet 3 percent of load with renewable resources by 2012, and is on track to meet the RPS requirements of 9 percent by 2016 and 15 percent by 2020. RPS provisions vary widely among the different jurisdictions in the absence of a federal mandate. Differences include the specific portion of renewable resources required, the timeline to meet the requirements, the types of resources that qualify as "renewable," the geographic location renewable resources can be sourced from, eligible commercial on-line dates and any applicable technology carve-outs (such as solar). The result is a patchwork of regulatory mandates, evolving regulations and segregated environmental markets. Managing these moving parts is complex from both a resource acquisition perspective and an environmental markets perspective.

Figure C-1, below, illustrates the wide variety of RPS requirements that exist. The table in Figure C-2 lists the current RPS requirements for each state within the Western Interconnect.[3]

Figure C-1: RPS Requirements by State



3 / Per Figure C-2, State RPS and Eligible Technologies (as of October 2014) are drawn from the Western Interstate Energy Board's publication Exploring and Evaluating Modular Approaches to Multi-State compliance with EPA's Clean Power Plan in the West, April 29, 2015.

Figure C-2: RPS Requirements for States in the Western Interconnect

State	RPS	Existing Renewable Generation	Eligible Renewable Energy
Arizona	20% by 2025	294 GWh	Solar water heat, solar space heat, solar thermal electric, solar thermal process heat, photovoltaics, landfill gas, wind, biomass, hydroelectric, geothermal electric, geothermal heat pumps, combined heat and power (CHP)/cogeneration (CHP only counts when the source fuel is an eligible RE resource), solar pool heating (commercial only), daylighting (nonresidential only), solar space cooling, solar HVAC, anaerobic digester, small hydroelectric, fuel cells using renewable fuels, geothermal direct-use, additional technologies upon approval*
California	20% by 12/31/13 25% by 12/31/16 33% by 2020 50% by 2030 (proposed)	3,350 GWh	Solar thermal electric, photovoltaics, landfill gas, wind, biomass, geothermal electric, municipal solid waste, energy storage, anaerobic digestion, small hydroelectric, tidal energy, wave energy, ocean thermal, biodiesel, and fuel cells using renewable fuels
Colorado	Investor-owned utilities (IOUs): 30% by 2020; Co-ops serving >100,000 meters: 20% by 2020; Co-ops serving <100,000 meters: 10% by 2020; Municipal utilities serving >40,000 customers: 10% by 2020	666 GWh	Solar thermal electric, photovoltaics, landfill gas, wind, biomass, hydroelectric, geothermal electric, recycled energy, coal mine methane (if the Colorado Public Utilities Commission determines it is a GHG-neutral technology), pyrolysis of municipal solid waste (if the Commission determines it is a GHG-neutral technology), anaerobic digester, and fuel cells using renewable fuels
Idaho	None	287 GWh	N/A
Montana	15% by 2015	197 GWh	Solar thermal electric, photovoltaics, landfill gas, wind, biomass, hydroelectric, geothermal electric, compressed air energy storage, battery storage, flywheel storage, pumped hydro (from eligible renewables), anaerobic digester, and fuel cells using renewable fuels
New Mexico	IOUs: 20% by 2020; Rural electric cooperatives: 10% by 2020	203 GWh	Solar thermal electric, photovoltaics, landfill gas, wind, biomass, hydroelectric, geothermal electric, zero emission technology with substantial long-term production potential, anaerobic digester, and fuel cells using renewable fuels
Nevada	25% by 2025	357 GWh	Solar water heat, solar space heat, solar thermal electric, solar thermal process heat, photovoltaics, landfill gas, wind, biomass, hydroelectric, geothermal electric, municipal solid waste, waste tires (using microwave reduction), energy recovery processes, solar pool heating, anaerobic digestion, biodiesel, and geothermal direct use
Oregon	Large utilities: 25% by 2025; Small utilities: 10% by 2025; Smallest utilities: 5% by 2025	499 GWh	Solar thermal electric, photovoltaics, landfill gas, wind, biomass, hydroelectric, geothermal electric, municipal solid waste, hydrogen, anaerobic digestion, tidal energy, wave energy, and ocean thermal
Utah	Voluntary goal: 20% by 2025	90 GWh	N/A
Washington	15% by 2020 and all cost-effective conservation	631 GWh	Solar thermal electric, photovoltaics, landfill gas, wind, biomass, hydroelectric, geothermal electric, anaerobic digestion, tidal energy, wave energy, ocean thermal, and biodiesel
Wyoming	None	357 GWh	N/A

NOTE: Approved technologies are generated in the state (excluding hydro generation). In many cases, generation in one state is used for RPS compliance in a different state.

PSE must actively monitor RPS requirements throughout the Western region, because the interconnectedness of the grid and regional energy markets means that changes in one state can have a pronounced impact on the entire system. In particular, PSE pays close attention to requirements in Oregon, California, and Idaho (which currently has no RPS).

California Renewable Portfolio Standard. The size and aggressiveness of California's RPS mandate make it the region's primary driver of renewable resource availability and cost, REC product availability and cost, and transmission and integration.

California has one of, if not *the* most aggressive RPS mandate in the nation. Senate Bill 1078 established the California RPS program in 2002. Governor Schwarzenegger sought to accelerate the standard, asking for 20 percent by 2010; this became law when he signed Senate Bill 107. In 2008, Schwarzenegger signed Executive Order S-14-08, which increased the requirement to 33 percent by 2020. Two RPS bills were passed at the end of the 2009 legislative session, however, the governor elected not to sign either. Instead, he signed Executive Order S-21-09, which allowed the California Air Resources Board (CARB), under its AB 32 authority, to adopt a regulation consistent with the 33 percent RPS target established in Executive Order S-14-08. In 2010, the CARB adopted its Renewable Electricity Standard (RES), requiring 33 percent by 2020. Legislative endorsement of this standard was achieved when Governor Jerry Brown signed Senate Bill SB 2 (1X) into law in April 2011.

SB 2 (1X) extends the original RPS goal from 20 percent of retail sales by the end of 2010 to 33 percent of retail sales by 2020 for all California independently owned utilities (IOUs), electric service providers (ESPs) and the community choice aggregators (CCAs); it also obligates publically owned utilities to meet these goals. In addition, the new law modifies many details of the program and creates portfolio content categories for RPS procurement. The California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) were tasked with implementing the expanded RPS. In December 2011, the CPUC issued a decision that addressed the criteria for inclusion in each of the new RPS portfolio content categories and the percentage of the annual procurement target that could be sourced from unbundled RECs. The use of unbundled renewable energy credits was capped at 25 percent of a utility's RPS requirement through December 31, 2013; this steps down to 15 percent in 2014 and 10 percent in 2017. The decision applies to contracts and ownership agreements entered into after June 1, 2010.

ELECTRIC RESOURCES AND ALTERNATIVES

Contents

This appendix describes the different types of electric resources available to PSE. It presents an inventory of PSE's existing electric resources and then describes current electric resource alternatives, including information about the viability and availability of each resource for PSE and estimated ranges for capital and operating costs.[1]

1 / *Operating costs are defined as operation and maintenance costs, insurance and property taxes. Capital costs are defined as depreciation and carrying costs on capital expenditures.*

RESOURCE TYPES

It is helpful to understand some of the distinctions used to classify electric resources.

Supply-side and Demand-side. Both of these types of resources are capable of enabling PSE to meet customer loads. They are different, however, and they originate on different sides of the meter. Supply-side resources provide electricity to meet load and originate on the utility side of the meter. Demand-side resources reduce load and originate on the customer side of the meter. An "integrated" resource plan includes both supply- and demand-side resources.

SUPPLY-SIDE RESOURCES for PSE include:

- All of PSE's generating plants, regardless of how they are fueled (by natural gas, coal, water or wind)
- Long-term contracts with independent producers to supply electricity to PSE (these also have a variety of fuel sources)
- Transmission contracts with Bonneville Power Administration (BPA) to carry electricity from short-term wholesale market purchases to PSE's service territory

DEMAND-SIDE RESOURCES for PSE include:

- Energy efficiency programs
- Customer programs

The contribution that demand-side programs make to meeting resource need is accounted for as a reduction in demand for the IRP analysis.

Thermal and Renewable. These supply-side resources are distinguished by the type of fuel they use.

THERMAL RESOURCES use fossil or other fuels to generate electricity (gas, oil, coal, uranium). PSE's gas-fired and coal-fired generating facilities are thermal resources.

RENEWABLE RESOURCES use renewable fuels such as water, wind, sunlight and biomass to generate electricity. Hydroelectricity and wind generation are PSE's primary renewable resources.

Baseload, Peaking and Intermittent. These distinctions refer to how the resource functions within the system.

BASELOAD RESOURCES are capable of generating electricity economically over long periods of time. They can often "follow load," which means they are capable of increasing output when demand is high and decreasing output when demand is low (but they cannot respond as quickly as peaking resources).

PSE's three sources of baseload energy are natural-gas fired combined-cycle combustion engines, hydroelectric generation and coal-fired generation.

PEAKING RESOURCES are generators that can ramp up and down quickly in order to meet spikes in need. They are typically not deployed for long periods of time because they are not as economical to operate as baseload resources.

Peaking resources can also provide flexibility to the portfolio by providing load following, wind integration and spinning reserves.

Simple-cycle combustion turbines are PSE's main peaking resource; some hydro-electric plants can also perform peaking functions.

INTERMITTENT RESOURCES experience big fluctuations in their generating patterns because their fuel sources are not constant – such as wind and solar. Since those fluctuations don't necessarily correspond to the fluctuations in customer demand, other resources need to be standing by to fill in when the wind dies down or the sun goes behind a cloud.

PSE's largest intermittent resource is wind generation; rooftop solar generation is also an intermittent resource. PSE has several smaller intermittent resources represented by co-generation and small power production which provide about 10 aMW of annual energy.

All generation and market purchases, whether baseload, peaking or intermittent, are subject to random and unforeseen curtailment and forced outage events, so for planning purposes, PSE cannot rely upon these resources 100 percent of the time to meet loads.

Capacity Values. The tables in the following pages describe PSE's existing electric resources using the net maximum capacity of each plant in megawatts (MW). Net maximum capacity is the capacity a unit can sustain over a specified period of time – in this case 60 minutes – when not restricted by ambient conditions or de-ratings, less the losses associated with auxiliary loads and before the losses incurred in transmitting energy over transmission and distribution lines. This is consistent with the way plant capacities are described in the annual 10K report[2] that PSE files with the U.S. Securities and Exchange Commission and the Form 1 report filed with the Federal Energy Regulatory Commission (FERC).

Different plant capacity values are referenced in other PSE publications because plant output varies depending upon a variety of factors, among them ambient temperature, fuel supply, whether a natural gas plant is using duct firing, whether a combined-cycle facility is delivering steam to a steam host, outages, upgrades and expansions. To describe the relative size of resources, it is necessary to select a single reference point based on a consistent set of assumptions. Depending on the nature and timing of the discussion, these assumptions – and thus the expected capacity – may vary.

2 / PSE's most recent 10K report was filed with the U.S. Securities and Exchange Commission in March 2015 for the year ending December 31, 2014. See http://www.pugetenergy.com/pages/filings.html.

EXISTING RESOURCES INVENTORY

Within each of the following sections, resources are listed in alphabetical order.

Supply-side Thermal Resources

Coal. Reliable, low-cost electricity from the Colstrip generating plant currently supplies 18 to 20 percent of PSE's baseload energy needs.

THE COLSTRIP GENERATING PLANT. Located in eastern Montana about 120 miles southeast of Billings, the plant consists of four coal-fired steam electric plant units. PSE owns 50 percent each of Units 1 & 2 and 25 percent each of Units 3 & 4. PSE's total ownership in Colstrip contributes 677 MW Net Maximum Capacity to the existing portfolio. Appendix K, Colstrip, delivers a detailed description of the facility and its operations, ownership, history and applicable environmental regulations.

Gas-fired Combined-cycle Combustion Turbines (CCCTs). PSE's six CCCT resources have a combined net maximum capacity of 1,276 MW and supply 19 to 24 percent of PSE's baseload energy needs, depending on market heat rates and plant availabilities. In a CCCT, the heat that a simple-cycle combustion turbine produces when it generates power is captured and used to create additional energy. This makes it a more efficient means of generating power than the simple-cycle turbines listed below. PSE's CCCT fleet includes the following.

MINT FARM is located in Cowlitz County, Wash.

FREDERICKSON 1 is located in Pierce County, Wash. (PSE owns 49.85 percent of this plant; the remainder of the plant is owned by Atlantic Power Corporation.)

GOLDENDALE is located in Klickitat County, Wash.

ENCOGEN, FERNDALE and **SUMAS** are located in Whatcom County, Wash.

Figure D-1: PSE's Owned Coal and CCCT Resources

POWER TYPE	UNITS	PSE OWNERSHIP	NET MAXIMUM CAPACITY (MW)[1]
Coal	Colstrip 1 & 2	50%	307
Coal	Colstrip 3 & 4	25%	370
Total Coal			**677**
CCCT	Encogen	100%	165
CCCT	Ferndale[3]	100%	273
CCCT	Frederickson 1[2,3]	49.85%	136
CCCT	Goldendale[3]	100%	278
CCCT	Mint Farm[3]	100%	297
CCCT	Sumas	100%	127
Total CCCT			**1,276**

NOTES
1 Net maximum capacity reflects PSE's share only.
2 Frederickson 1 CCCT unit is co-owned with Atlantic Power Corporation - USA.
3 Maximum capacity of Ferndale, Frederickson 1, Goldendale and Mint Farm includes the capacity of duct firing.

Gas-fired Simple-cycle Combustion Turbines (SCCTs). These resources provide important peaking capability and help us to meet operating reserve requirements. The company displaces these resources when the energy is not needed to serve load or lower-cost energy is available for purchase. PSE's four simple-cycle combustion turbine plants contribute a net maximum capacity of 612 MW. When pipeline capacity is not available to supply them with natural gas fuel, these units are capable of operating on distillate fuel oil.

FREDONIA Units 1, 2, 3 and 4 are located near Mount Vernon, Wash., in Skagit County.

WHITEHORN Units 2 and 3 are located in northwestern Whatcom County, Wash.

FREDERICKSON Units 1 and 2 are located south of Seattle in east Pierce County, Wash.

Ownership and net maximum capacity are shown in Figure D-2 below.

Figure D-2: PSE's Owned Simple-cycle Combustion Turbines

NAME	PSE OWNERSHIP	NET MAXIMUM CAPACITY (MW)
Fredonia 1 & 2	100%	207
Fredonia 3 & 4	100%	107
Whitehorn 2 & 3	100%	149
Frederickson 1 & 2	100%	149
Total SCCT		**612**

Supply-side Renewable Resources

Hydroelectricity. Hydroelectricity supplies between 19 and 24 percent of PSE's baseload energy needs. Even though restrictions to protect endangered species limit the operational flexibility of hydroelectric resources, these generating assets are valuable because of their ability to instantly follow customer load and because of their low cost relative to other power resources. High precipitation and snowpack levels generally allow more power to be generated, while low-water years produce less power. During low-water years, the utility must rely on other, more expensive, self-generated power or market resources to meet load. The analysis conducted for this IRP accounts for both seasonality and year-to-year variations in hydroelectric generation. PSE owns hydroelectric projects in western Washington and has long-term purchased-power contracts with three public utility districts (PUDs) that own and operate large dams on the Columbia River in Central Washington. In addition, we contract with smaller hydroelectric generators located within PSE's service territory.

Figure D-3: PSE Owned and Contracted Hydroelectric Resources

PLANT	OWNER	PSE SHARE %	NET MAXIMUM CAPACITY (MW)[1]	CONTRACT EXPIRATION DATE
Upper Baker River	PSE	100	91	None
Lower Baker River	PSE	100	109	None
Snoqualmie Falls	PSE	100	48[2]	None
Total PSE-Owned			248	
Wells	Douglas Co.	29.89	231[3]	8/31/18[3]
Rocky Reach	Chelan Co. PUD	25.0	325	10/31/31
Rock Island I & II	Chelan Co. PUD	25.0	156	10/31/31
Wanapum	Grant Co. PUD	0.64	7	04/04/52
Priest Rapids	Grant Co. PUD	0.64	6	04/04/52
Mid-Columbia Total			725	
Total Hydro			973	

NOTES
1 Net maximum capacity reflects PSE's share only.
2 FERC license authorizes the full 54.4 MW; however, the project's water right, issued by the state department of ecology, limits flow to 2,500 cfs and, therefore, output to 47.7 MW.
3 Wells has one turbine out for the next many years which reduces its peaking capability in total from 840 MW to 774 MW and PSE's share of this to 231 MW. For the purposes of this IRP, PSE assumes the Wells hydroelectric contract is renegotiated at a lower share through the end of the IRP time horizon (2035).

BAKER RIVER HYDROELECTRIC PROJECT. This facility is located in Washington's north Cascade Mountains. It consists of two dams and is the largest of PSE's hydroelectric power facilities. The project contains modern fish-enhancement systems including a "floating surface collector" (FSC) to safely capture juvenile salmon in Baker Lake for downstream transport around both dams, and a second, newer FSC on Lake Shannon for moving young salmon around Lower Baker Dam. In addition to generating electricity, the project provides public access for recreation and significant flood-control storage for people and property in the Skagit Valley. Hydroelectric projects require a license from FERC for construction and operation. These licenses normally are for periods of 30 to 50 years and then they must be renewed to continue operations. In October 2008, after a lengthy renewal process, FERC issued a 50-year license allowing PSE to generate approximately 710,000 MWh per year (average annual output) from the Baker River project. PSE also completed construction of a new powerhouse and 30 MW generating unit at Lower Baker dam in July 2013. The new unit improves river flows for fish downstream of the dam while producing more than 100,000 additional MWh of energy from the facility each year. This incremental energy qualifies as a renewable resource under Washington State's Energy Independence Act, RCW 19.285.

SNOQUALMIE FALLS HYDROELECTRIC PROJECT. Located east of Seattle on the Cascade Mountains' western slope, the Snoqualmie Falls Hydroelectric Project consists of a small diversion dam just upstream from Snoqualmie Falls and two powerhouses. The first powerhouse, which is encased in bedrock 270 feet beneath the surface, was the world's first completely underground power plant. Built in 1898-99, it was also the Northwest's first large hydroelectric power plant. FERC issued PSE a 40-year license for the Snoqualmie Falls Hydroelectric Project in 2004. The terms and conditions of the license allow PSE to generate an estimated 275,000 MWh per year (average annual output). The facility recently underwent a major redevelopment project which included substantial upgrades and enhancements to the power-generating infrastructure and public recreational facilities. Efficiency improvements completed as part of the redevelopment will increase annual output by over 22,000 MWh. This incremental energy qualifies as a renewable resource under Washington State's Energy Independence Act, RCW 19.285.

MID-COLUMBIA LONG-TERM PURCHASED POWER CONTRACTS. Under long-term purchased-power agreements with three PUDs, PSE purchases a percentage of the output of five hydroelectric projects located on the Columbia River in Central Washington. PSE pays the PUDs a proportionate share of the cost of operating these hydroelectric projects. The agreement with Douglas County PUD for the purchase of 29.89 percent of the output of the Wells project expires in 2018 and PSE is in the process of negotiating an extension to this contract which has been included in the resource assumptions for this IRP. PSE has a 20-year agreement with Chelan County PUD for the purchase of 25 percent of the output of the Rocky Reach and Rock Island projects that extends through October 2031. PSE has an agreement with Grant County PUD for a 0.64 percent share of the combined output of the Wanapum and Priest Rapids developments. The agreement with Grant County PUD will continue through the term of the project's FERC license, which ends April 4, 2052.

Wind Energy. PSE is the largest utility owner and operator of wind-power facilities in the Northwest. Combined, the company's three wind farms maximum capacity is 773 MW. They are forecast to produce on average, more than 2 million MWhs of power per year, which is about 8 to 9 percent PSE's energy needs. These resources are integral to meeting renewable resource commitments.

HOPKINS RIDGE. Located in Columbia County, Wash., Hopkins Ridge has an approximate maximum capacity of 157 MW. It began commercial operation in November 2005.

WILD HORSE. Located in Kittitas County near Ellensburg, Wash., Wild Horse has an approximate maximum capacity of 273 MW. It came online in December 2006 at 229 MW and was expanded by 44 MW in 2010.

LOWER SNAKE RIVER. PSE brought online its third and largest wind farm in February 2012. The 343 MW facility is located in Garfield County, Wash.

Figure D-4 presents details about the company's wind resources.

Figure D-4: PSE's Owned Wind Resources

POWER TYPE	UNITS	PSE OWNERSHIP	NET MAXIMUM CAPACITY (MW)
Wind	Hopkins Ridge	100%	157
Wind	Lower Snake River, Phase 1	100%	343
Wind	Wild Horse	100%	273
Total Wind			**773**

Solar Energy. The Wild Horse facility contains 2,723 photovoltaic solar panels, including the first made-in-Washington solar panels.[4] The array can produce up to 0.5 MW of electricity with full sun. Panels can also produce power under cloudy skies – 50 to 70 percent of peak output with bright overcast and 5 to 10 percent with dark overcast. The site receives approximately 300 days of sunshine per year, roughly the same as Houston, Tex. On average this site generates 780 MWhs of power per year.

Supply-side Contract Resources

Long-term contracts consist of agreements with independent producers and other utilities to supply electricity to PSE. Fuel sources include hydropower, gas, coal, waste products and system deliveries without a designated supply resource. These contracts are summarized in Figure D-5. Short-term wholesale market purchases negotiated by PSE's energy trading group are not included in this listing.

BPA – WNP-3 BONNEVILLE EXCHANGE POWER. This is a system-delivery, not a unit-specific, purchased power contract. The agreement resulted from PSE and others claims against the Bonneville Power Administration (BPA) regarding its action to halt construction on nuclear project WNP-3 in 1984, in which PSE had a 5 percent interest. Under the agreement, in effect until June 2017, PSE receives power during the winter months from BPA according to a formula based on the average equivalent annual availability and cost factors of surrogate nuclear plants similar in design to WNP-3. In exchange, PSE provides power to BPA from its combustion turbines, if requested and warranted under the contract terms, except during the month of May.

POINT ROBERTS PPA. This contract provides for power deliveries to PSE's retail customers in Point Roberts, Wash. The Point Roberts load, which is physically isolated from PSE's transmission system, connects to British Columbia Hydro's electric distribution facilities. We pay a fixed price for the energy during the term of the contract.

4 / Outback Power Systems (now Silicon Energy) in Arlington produced the first solar panels in Washington. The Wild Horse Facility was Outback Power Systems' launch facility, utilizing 315 of their panels. The remaining panels were produced by Sharp Electronics in Tennessee.

BAKER REPLACEMENT. Under a 20-year agreement signed with the U.S. Army Corps of Engineers (COE) PSE provides flood control for the Skagit River Valley. Early in the flood control period, we draft water from the Upper Baker reservoir at the request of the COE. Then, during periods of high precipitation and runoff between October 15 and March 1, we store water in the Upper Baker reservoir and release it in a controlled manner to reduce downstream flooding. In return, PSE receives a total of 7,000 MWhs of power and 7 MW of maximum capacity from BPA in equal increments per month for the months of November through February to compensate for the lower generating capability caused by reduced head due to the early drafting at the plant during the flood control months.

PACIFIC GAS & ELECTRIC COMPANY (PG&E) SEASONAL EXCHANGE. Each calendar year PSE exchanges with PG&E 300 MW of seasonal capacity, together with 413,000 MWh of energy, on a one-for-one basis, under this system-delivery power exchange contract. PSE is a winter-peaking utility and PG&E is a summer-peaking utility, so PG&E has the right to call for the power in the months of June through September, and PSE has the right to call for the power in the months of November through February.

CANADIAN ENTITLEMENT RETURN. Under a treaty between the United States and Canada, one-half of the firm power benefits produced by additional storage capability on the Columbia River in Canada accrue to Canada. PSE's benefits and obligations from this storage are based on the percentage of our participation in the Columbia River projects. Agreements with the Mid-Columbia PUDs specify PSE's share of the obligation is to return one-half of the firm power benefits to Canada during peak hours until the expiration of the PUD contracts or expiration of the Columbia River Treaty, whichever occurs first. The Columbia River Treaty will not expire prior to 2024. This is energy that PSE provides rather than receives, so it is a negative number. The energy returned during 2014 was approximately 20.4 aMW with a peak capacity return of 37.4 MW.

ELECTRON HYDROELECTRIC PROJECT PPA. In November 2014, PSE sold the Electron Project and associated water rights to an independent power producer. PSE will purchase the output of the Electron Project under a power purchase agreement with the new owner that extends through 2026.

COAL TRANSITION PPA. Under the terms of this agreement, PSE will buy 180 MW of firm, baseload coal transition power from TransAlta's Centralia coal plant starting in December 2014. On December 1, 2015, the contract increases to 280 MW. From December 2016 to December 2024 the contract is for 380 MW, and in the last year the contract volume drops to 300 MW. This contract advances a separate TransAlta agreement with state government and the environmental community to phase out coal-fired power generation in Washington by 2025. The state Legislature in 2011 passed a bill codifying a collaborative agreement between TransAlta, lawmakers, environmentalists and labor representatives. The timelines agreed to by the parties enable the state to make the transition to cleaner fuels, while preserving the family-wage jobs and economic benefits associated with the low-cost, reliable power provided by the Centralia plant. The legislation allows long-term contracts, through 2025, for sales of coal transition power associated with the 1,340-megawatt (MW) Centralia facility, Washington's only coal-fired plant.

KLAMATH PEAKER TOLL. This tolling contract between PSE and Iberdrola Renewables is designed to help PSE meet its customers' peak winter electricity demand. During winter months (November through February) through February 2016, PSE can call upon 100 MW of energy from the Klamath natural gas-fired peaking facility in Klamath Falls, Ore.

KLONDIKE III PPA. PSE's wind portfolio includes a power purchase agreement with Iberdrola Renewables for a 50 MW share of electricity generated at the Klondike III wind farm in Sherman County, Ore. The wind farm has 125 turbines with a project capacity of 224 MW. This agreement remains in effect until November 2026.

HYDROELECTRIC PPAs. Among PSE’s power purchase agreements are four long-term contracts for the output of production from hydroelectric projects within its balancing area. These contracts were establish through PSE’s RFP process and are shown in Figure D-5 below. The projects are run-of-river and do not provide any flexible capacity.

SCHEDULE 91 CONTRACTS. PSE's portfolio includes a number of electric power contracts (included in Figure D-5) with small power producers in PSE’s electric service area. These Qualifying Facilities offer output pursuant to WAC-107-095. Part one of this statute states that "A utility must purchase electric energy, electric capacity, or both from a qualifying facility on terms that do not exceed the utility's avoided costs for such electric energy, electric capacity, or both." A qualifying facility is defined by WAC 480-107-007 as a generating facility "that meet(s) the criteria specified by the FERC in 18 C.F.R. Part 292 Subpart B."

Figure D-5: Long-term Contracts for Electric Power Generation (continued next page)

NAME	POWER TYPE	CONTRACT EXPIRATION	CAPACITY (MW)[1]
BPA- WNP-3 Exchange	System	6/30/2017	82
Pt. Roberts[2]	System	9/30/2019, but ongoing	8
Baker Replacement	Hydro	9/30/2029	7
Electron PPA	Hydro	12/31/2026	12.5[3]
PG&E Seasonal Exchange-PSE	Thermal	Ongoing	300
Canadian EA	Hydro	09/15/2024	(40.5)
Coal Transition PPA	Transition Coal	12/31/2025	180[4]
Klamath Peaker Toll	Natural Gas	2/29/2016	100
Klondike III PPA	Wind	11/30/2027	50
Twin Falls PPA	Hydro-QF	2/28/2025	15.3
Koma Kulshan PPA	Hydro-QF	3/31/2037	10.9
Weeks Falls PPA	Hydro-QF	11/30/2022	4.6
Hutchinson Creek PPA	Hydro-QF	9/30/2016	0.9
Farm Power Lynden	Schedule 91 - Biogas	12/31/2019	0.75
Farm Power Rexville	Schedule 91 - Biogas	12/31/2019	0.75
Rainier Biogas	Schedule 91 – Biogas	12/31/2020	1.0
Vanderhaak Dairy	Schedule 91 – Biogas	12/31/2019	0.60
Van Dyk - Holsteins Dairy	Schedule 91 – Biogas	12/31/2020	0.472
Bio Energy Washington	Schedule 91 - Biogas	12/31/2021	1.20
Edaleen Dairy	Schedule 91 – Biogas	12/31/2021	0.75
BioFuels Washington	Schedule 91 – Biogas	12/31/2021	4.50
Skookumchuck	Schedule 91 – Hydro	12/31/2020	1.0
Smith Creek	Schedule 91 – Hydro	12/31/2020	0.12
Black Creek	Schedule 91 – Hydro	3/24/2021	4.2
Nooksack Hydro	Schedule 91 – Hydro	12/31/2021	3.5
Island Solar	Schedule 91 – Solar	5/09/2021	0.075
Finn Hill Solar (Lake Wash SD)	Schedule 91 – Solar	12/31/2021	0.355
CC Solar #1, LLC and CC Solar #2, LLC	Schedule 91 – Solar	12/31/2026	0.026
Knudson Wind	Schedule 91 – Wind	12/31/2019	0.108
3 Bar-G Wind	Schedule 91 – Wind	12/31/2019	0.12
Swauk Wind	Schedule 91 – Wind	12/31/2021	4.25
Total			**755**

NOTES
1 Capacity reflects PSE share only.
2 The contract to provide power to PSE's Point Roberts customers expires 9/30/2017, but is expected to be renegotiated and continue past that date as Point Roberts is not physically interconnected to PSE's system.
3 The capacity reflects contract before May 2016. The capacity increases to 23.8MW after Nov. 2016.
4 The capacity of the TransAlta Centralia PPA is designed to ramp up over time to help meet PSE's resource needs. According to the contract, PSE will receive 180 MW from 12/1/2014 to 11/30/2015, 280 MW from 12/1/2015 to 11/30/2016, 380 MW from 12/1/2016 to 12/31/2024 and 300 MW from 1/1/2025 to 12/31/2025.

Supply-side Transmission Resources

Transmission capacity to the Mid-Columbia (Mid-C) market hub gives PSE access to the principal electricity market hub in the Northwest which is one of the major trading hubs in the Western Electricity Coordinating Council (WECC). It is the central market for northwest hydroelectric generation. The majority of PSE's transmission to the Mid-C market is contracted from BPA on a long-term basis; in addition to these contracts, PSE also owns 450 MW of transmission capacity to Mid-C.[5]

PSE's Mid-C transmission capacity is detailed in Figure D-6 below; 1,600 MW of this capacity to the Mid-C wholesale market comprises a significant portion of the of capacity required to meet PSE's peak need.[6]

5 / PSE also owns transmission and transmission contracts to other markets, in addition to the Mid-C market transmission detailed here.
6 / See Chapter 6, Electric Analysis, for a more detailed discussion of PSE reliance on wholesale market capacity to meet peak need.

Figure D-6: Mid-C Hub Transmission Resources as of 8/1/2015

NAME	EFFECTIVE DATE	TERMINATION DATE	TRANSMISSION DEMAND (MW)
BPA Mid-C Transmission			
Midway	11/1/2012	11/1/2017	100
Midway	10/1/2013	10/1/2018	115
Midway	3/1/2014	3/1/2019	35
Midway	4/1/2008	11/1/2035	5
Rock Island	7/1/2007	7/1/2037	400
Rocky Reach	11/1/2012	11/1/2017	100
Rocky Reach	11/1/2012	11/1/2017	100
Rocky Reach	11/1/2014	11/1/2019	40
Rocky Reach	11/1/2014	11/1/2019	40
Rocky Reach	11/1/2014	11/1/2019	40
Rocky Reach	11/1/2014	11/1/2019	5
Rocky Reach	11/1/2014	11/1/2019	55
Rocky Reach	12/1/2014	11/30/2031	160
Vantage	11/1/2012	11/1/2017	100
Vantage	12/1/2014	12/1/2019	169
Vantage	10/1/2013	3/1/2025	3
Vantage	11/1/2014	11/1/2019	27
Vantage	11/1/2014	11/1/2019	27
Vantage	11/1/2014	11/1/2019	27
Vantage	11/1/2014	11/1/2019	3
Vantage	11/1/2014	11/1/2019	36
Vantage	11/1/2014	11/1/2019	5
Wells	1/24/1966	9/1/2018	266
NWE Purchase IR Conversion	10/1/2011	10/1/2016	94
Vantage	5/1/2014	3/1/2021	23
Total BPA Mid-C Transmission			**1,975**
PSE Owned Mid-C Transmission			
McKenzie to Beverly	-	-	50
Rocky Reach to White River	-	-	400
Total PSE Mid-C Transmission			**450**
Total Mid-C Transmission			**2,425**

As shown, PSE has a total of 2,425 MW of capacity to the Mid-C market hub: 1,975 MW in BPA contracts and 450 MW of owned capacity. Figure D-6 also shows the BPA contract periods. The NWE Purchase IR Conversion will not be renewed when it expires in October 2016; this will reduce BPA contracted Mid-C transmission to 1,881 MW beginning October 1, 2016.

Demand-side Energy Efficiency Resources

Existing demand-side resource (DSR) programs consist of:

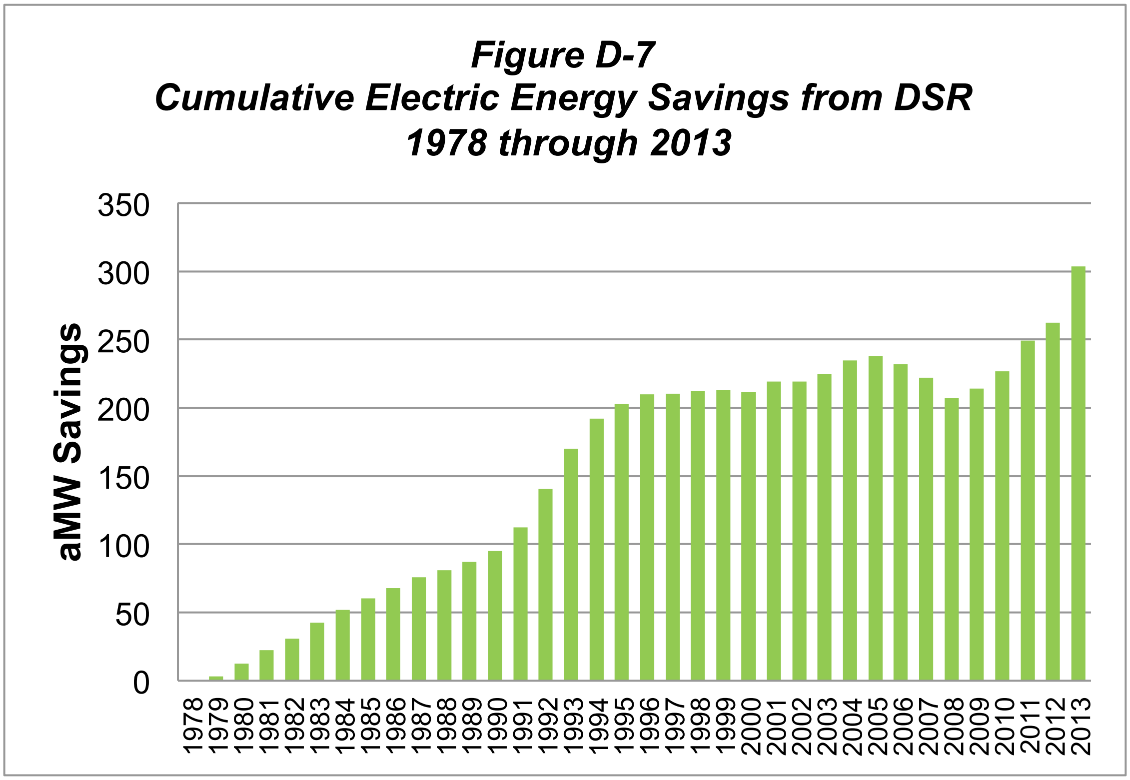
- **ENERGY EFFICIENCY**, implemented by PSE's Customer Energy Management (CEM) group
- **FUEL CONVERSION**, implemented by PSE's Customer Energy Management (CEM) group
- **DISTRIBUTION EFFICIENCY**, managed by the System Planning department
- **GENERATION EFFICIENCY**, evaluated by PSE's Customer Energy Management (CEM) group. (This represents energy efficiency opportunities at PSE generating facilities.)
- **DISTRIBUTED GENERATION**, overseen by the Customer Renewable Energy Programs group.

Energy efficiency is by far the largest electric demand-side resource. Energy efficiency programs serve all types of customers – residential, low-income, commercial and industrial. Program savings targets are established every two years in collaboration with key external stakeholders represented by the Conservation Resource Advisory Group (CRAG) and Integrated Resource Plan Advisory Group (IRPAG). The majority of electric energy efficiency programs are funded using electric "conservation rider" funds collected from all customer classes.[7]

Since 1978, annual first-year savings (as reported at the customer meter) have increased more than 450 percent, from 9 aMW in 1978 to 43 aMW in 2014. The cumulative investment and power savings from 1978 through 2014 are approximately $1.1 billion and 350 aMW respectively. The savings are adjusted for measure life, so that savings from very early programs that are past the measure life are not counted. Figure D-7 shows the cumulative savings from 1978 through 2014. By 2014, those savings represented enough electrical energy to serve more than 250,000 homes for a year.

7 / *See Electric Rate Schedule 120, Electricity Conservation Service Rider, for more information.*

Figure D-7: Cumulative Electric Energy Savings from DSR, 1978 through 2014



In the most recently completed program cycle, the 2012-13 tariff period, energy efficiency (including fuel conversion) achieved a total savings of 80 aMW; the target for the current 2014-15 program cycle is 70.9 aMW. The savings impact from the most recent program cycles is mitigated somewhat by earlier programs reaching the end of their productive lives, causing those savings "drop off" the chart in Figure D-7.

Electric Energy Efficiency Programs. The two largest programs offered by PSE to customers are the Commercial and Industrial Retrofit program and the Single Family Residential Lighting program.

THE COMMERCIAL AND INDUSTRIAL RETROFIT PROGRAM. This program offers expert assistance and grants to help existing commercial and industrial customers use electricity more efficiently via cost-effective and energy efficient equipment, designs and operations. The program spent more than $17 million (mostly in grants) to over 520 business customers in 2014 to achieve savings of over 74,000 MWh.

THE SINGLE FAMILY RESIDENTIAL LIGHTING PROGRAM. This program offers rebates to single-family residential customers and builders who purchase Energy Star fixtures and compact fluorescent light bulbs. The program is delivered through various channels. The retail channel is by far the largest delivery mechanism; rebates are provided to the retail stores to reduce the cost of energy efficient lighting products. With a budget totaling more than $17 million, the program captured savings of over 103,000 MWh in 2014.

Figure D-8: Annual Energy Efficiency Program Summary, 2012-2014

Program	2012 - 2013 Actual	’12-’13 2-Year Budget/ Goal	‘12/’13 Actual vs. Budget % Total	2014 Actual	’14-’15 2-Year Budget/ Goal	’14 Actual vs. ‘14-15 % Total
Electric Program Costs	$ 190	$ 193	98.0%	$99	$ 188	53%
Megawatt Hour Savings	701,000	666,000	105%	378,540	621,000	61%
aMW Savings	80	76	105%	43	71	61%

Figure D-8 shows the combined performance of these two programs compared to two-year budget and savings goals for the biennial 2012-2013 electric energy efficiency programs; it also records 2014 progress against 2014-2015 budget and savings goals.

PSE’s electric energy efficiency programs saved a total of 80 aMW of electricity at a cost of $190 million during 2012-2013, surpassing energy savings goals while operating under budget. Through 2014, the 2014-2015 electric energy efficiency programs have saved 43 aMW of electricity at a cost of $99 million.

Fuel Conversion. The Fuel Conversion Program has been growing, albeit slowly, since its inception in 2010. In the most recent years, an average of 260 customers have participated in the program. See Figure D-9 below.

Figure D-9: Fuel Conversion Program 2012-2014

Year	Savings (kWh)	Budget Spent	Total Incentives $	Total Customers (rebates paid)
2012	1,531,500	$540,306.00	$339,879.00	250
2013	1,622,750	$649,666.00	$404,909.00	263
2014	1,741,000	$655,950.00	$456,970.00	270

PSE gas and electric customers and Cascade Natural Gas service territory customers are eligible to convert. Currently there is a minimum average requirement of 19,000 kWh to qualify for all incentives (with the exception of water-heat only). The kWh requirement and gas availability are barriers to participation.

Distribution Efficiency. This energy efficiency measure is accomplished through conservation voltage reduction (CVR) accompanied by load phase balancing. PSE began implementing distribution efficiency in 2013 and two substations were adapted in that year and another two in 2014. Work started on another four substations in 2014 and was completed in the third quarter of 2015. Five more substations are targeted for completion by the end of 2015. Figure D-10 summarizes the savings to date for the completed substations and estimates savings for those still to be completed in 2015.

Figure D-10: Distribution Efficiency Savings thru 2015

Substation	Year Completed	Annual kWh Savings	Notes
South Mercer	2013	607,569	Completed
Mercerwood	2013	357,240	Completed
Mercer Island	2014	859,586	Completed
Britton	2014	636,197	Completed
Panther Lake	2015	484,183	Completed 2015 Q3
Hazelwood	2015	546,003	Completed 2015 Q3
Inglewood	2015	533,607	Completed 2015 Q3
Pine Lakes	2015	627,167	Completed 2015 Q3
Cambridge	2015	403,044	Scheduled for end of 2015
Cresecent Harbor	2015	218,932	Scheduled for end of 2015
Lakota	2015	456,900	Scheduled for end of 2015
Rhodes Lake	2015	562,393	Scheduled for end of 2015
Vashon	2015	403,594	Scheduled for end of 2015
Total Estimated Savings		**6,696,415**	

Generation Efficiency. In 2014, PSE worked with the CRAG to refine the boundaries of what to include as savings under generation efficiency. It was determined that only parasitic loads[8] served directly by a generator would be included in the savings calculations as available for generation efficiency upgrades; generators whose parasitic loads are served externally – from the grid – would not be included. Using this definition, PSE has been conducting site assessments and expects that they will be completed in 2015. To date, the assessments have not yielded any cost effective measures. Figure D-11 summarizes the assessments to date.

Figure D-11: Summary of Generation Efficiency Assessment

PSE Generation Facilities	Measures Description	Measure Cost	Annual Energy Savings (kWh)	TRC[4]
Encogen[1]	Lighting Upgrade	$51,720	35,662	0.41
	VFDs: Make-up water pumps	TBD	0	
	VFDs: Condensate pumps	TBD	0	
	VFDs: Boiler feedwater pumps	TBD	0	
	VFDs: Cooling tower fans	TBD	0	
Ferndale	Lighting Upgrade	$56,800	38,899	0.41
Fredonia	Lighting Upgrade	$30,200	10,449	0.21
Fredrickson[2]	TBD	TBD	0	TBD
Goldendale[3]	Not eligible	0	0	
Lower Baker	TBD	0	0	TBD
Upper Baker	TBD	0	0	TBD
Mint Farm	Lighting Upgrade	$88,881	85,020	0.66
Sumas	Lighting Upgrade	$38,352	30,269	0.55
	VFDs: HP Pump	$360,000	189,216	0.4
	VFDs: IP Pump	$90,000	23,126	0.19
	VFDs: RW pumps	$120,000	59,568	0.38
Whitehorn	Lighting Upgrade	$35,215	3,848	0.07
Colstrip	**TBD**	$0	0	TBD
Totals			**476,057**	

NOTES
1 Encogen has variable frequency drive (VFD) projects that have been identified as energy efficient opportunities, but they have not been assessed for cost-effectiveness or potential savings.
2 Fredrickson is being evaluated by PSE Energy Management Engineering at this time. Potential savings estimate is to be determined.
3 Production facilities are not eligible as all equipment is powered by the grid.
4 TRC is total resource cost test.

8 / Electric generation units need power to operate the unit, including auxiliary pumps, fans, electric motors and pollution control equipment. Some generating plants may receive this power externally, from the grid; however, many use a portion of the gross electric energy generated by the unit for operations – which is referred to as the "parasitic load."

Demand-side Customer Programs

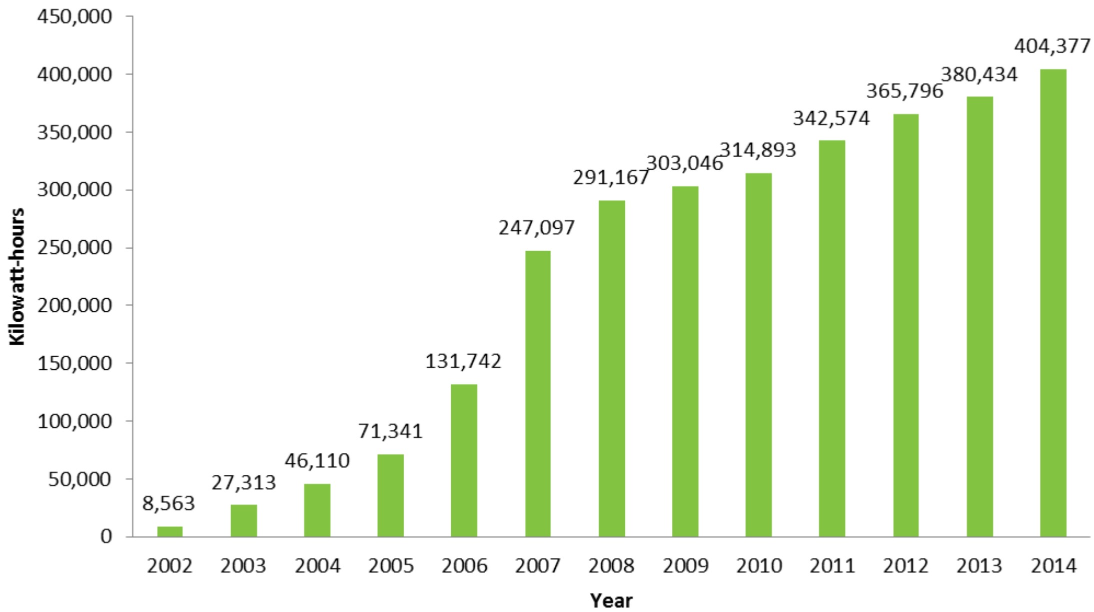
PSE’s customer renewable energy programs continue to grow. The Green Power Program serves customers who want to purchase additional renewable energy, and the Customer Renewables Program serves customers who generate renewable energy on a small scale. Our customers find value as well as social benefits in both programs, and PSE embraces and encourages their use.

Green Power Program. Launched in 2001, PSE’s Green Power Program allows customers to voluntarily purchase retail electric energy from qualified renewable energy resources. In 2009, we began working to increase participation in the program with 3Degrees, a third-party renewable energy credits (REC) broker that has developed and refined education and outreach techniques while working with other utility partners across the country. Customer growth has more than doubled since the original 3Degrees contract was initiated in January 2009. Participation increased by 16 percent and 10 percent in 2013 and 2014, respectively. As of December 31, 2014, over 4 percent of PSE electric customers are participating in the program. Between 2012 and 2014, the number of subscribers increased nearly 28 percent – from 34,962 to 44,688 – and the number of megawatt-hours purchased increased over ten percent, from 365,796 to 404,377.

Top 10

PSE has been recognized as one of the country’s top 10 utilities for Renewable Energy Sales and total Number of Green Power participants by the National Renewable Energy Laboratory since 2005.

Figure D-12: Green Power Kilowatt-hours Sold, 2002-2014



To supply green power, the program purchases RECs from a variety of sources. In the past two years, the majority of RECs have come from the Bonneville Environmental Foundation (BEF), a nonprofit environmental organization in Portland, Ore.; EDF Energy Services, a national REC broker; and 3Degrees, a REC broker based in San Francisco, Calif. These suppliers provide PSE's Green Power Program with RECs primarily from Pacific Northwest wind facilities. In addition, the Green Power Program currently purchases RECs directly from thirteen small, local producers in order to support the development of new small renewable resources. These include FPE Renewables, Farm Power Rexville, Farm Power Lynden, Edaleen Cow Power, Van Dyk-S Holsteins, Rainier Biogas, 3Bar G community wind, and First Up! Knudson community wind, Swauk Wind, Ellensburg Community Solar, Skagit Community Solar, BioFuels Washington and the Nooksack Hydro Facility – many of which also provide power to PSE under Schedule 91 contracts discussed above.

Over the last 9 years, the Green Power Program has also committed over $350,000 in grant funding to 14 cities for solar demonstration projects located on municipal facilities. For example, in 2013, the City of Mercer Island, Wash. installed a 4.4 KW system at their community center with $30,000 in grant funding from PSE. Some of the other projects have been installed throughout PSE's service territory, in Bellingham, Whidbey Island, Vashon and Olympia.

In 2013, the cities of Anacortes, Bainbridge Island, Kirkland and Tumwater were each awarded $20,000 grants for solar projects in their communities, and the City of Snoqualmie was awarded a $40,000 grant. The grants were in recognition of a successful multi-city Green Power Community Challenge campaign in which the five cities met individual goals for increased enrollment in the Green Power Program. The City of Snoqualmie received an additional $20,000 in recognition of achieving the highest percentage of new enrollments among available accounts during the 12-month challenge period. In 2014, a similar multi-city challenge was held with the cities of Redmond, Issaquah and Puyallup. All met their individual goals and each earned a $20,000 grant.

In 2013, PSE competitively awarded three-year REC contracts to the Bonneville Environmental Foundation and 3Degrees to help supply the balance of our Green Power Program portfolio needs in those three years. Pricing has remained relatively low, largely due to an increasing supply of renewable energy and the region's utilities having met their initial compliance targets. As a result, the Green Power Program has been able to focus on building a portfolio of RECs generated from wind, solar, biogas and low-impact hydro located primarily in Washington, with some additional supply from Oregon and Idaho.

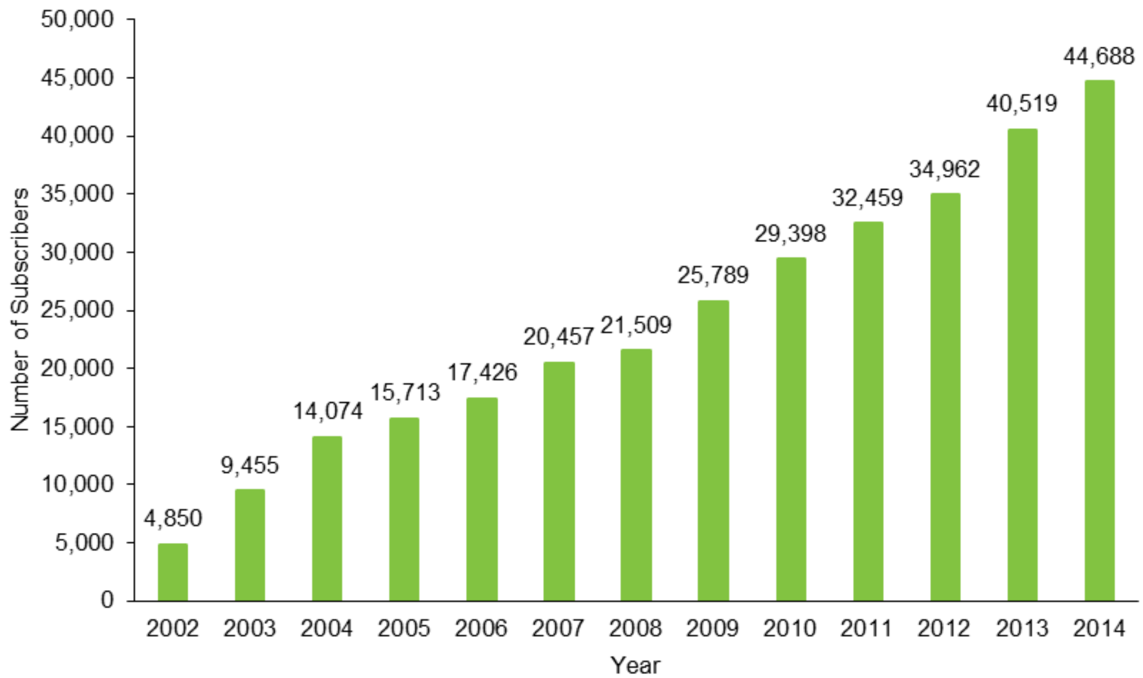
GREEN POWER RATES. The standard rate for green power is $0.0125 per kWh. Customers can purchase 160 kWh blocks for $2.00 per block with a two-block minimum, or they can choose to participate in the "100% Green Power Option." Introduced in 2007, this option adjusts the amount of the customer's monthly green power purchase to match their monthly electric usage.

The large-volume green power rate – $0.006 cent per kWh for customers who purchase more than 1,000,000 kWh annually – has attracted 27 customers since it was introduced in 2005.

In 2014, the average residential customer purchase was 640 kWh per month, and the average commercial customer purchase was 1,902 kWh. The average 2014 large-volume purchase, by account, under Schedule 136 was 14,390 kWh per month.

Figure D-13 illustrates the number of subscribers by year. Of our 44,688 Green Power subscribers at the end of 2014, 43,629 were residential customers, 790 accounts were commercial accounts, and 269 accounts were assigned under the large-volume commercial agreement. Cities with the most residential and commercial participants include Olympia with 5,348, Bellingham with 5,080, and Bellevue with 2,944.

Figure D-13: Green Power Subscribers, 2002-2014

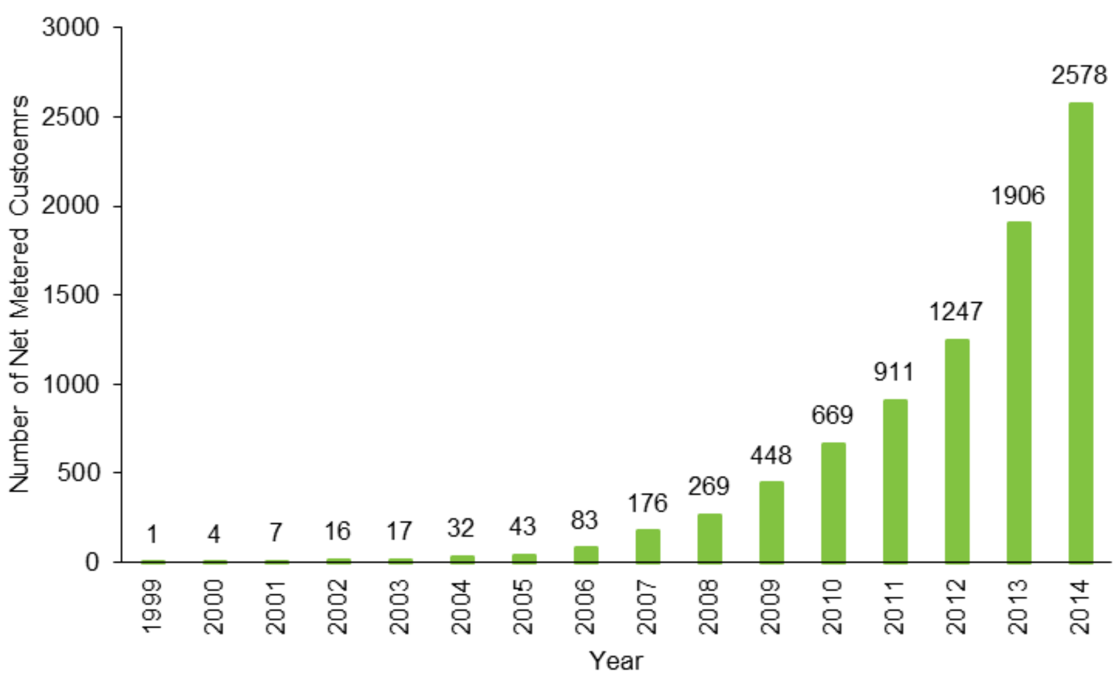


Customer Renewables Programs. PSE offers two customer renewables programs.

The **NET METERING PROGRAM**, which began in 1999, provides a way for customers who generate their own renewable electricity to offset the electricity provided by PSE. The amount of electricity that the customer generates and sends back to the grid is subtracted from the amount of electricity provided by PSE, and the net difference is what the customer pays on a monthly basis. A kWh credit is carried over to the next month if the customer generates more electricity than PSE supplies over the course of a month. The "banked" energy can be carried over until every April 30, when the account is reset to zero according to state law. The interconnection capacity allowed under net metering is 100 KW.

Customer interest in small-scale renewables has increased significantly over the past fifteen years, as Figure D-14 shows. For 2014, PSE added 672 new net metered customers for a total of 2,578.

Figure D-14: Net Metered Customers, 1999-2014



The vast majority of customer systems (98 percent) are solar photovoltaic (PV) installations with an average generating capacity of 6.25 KW, but there are also small-scale hydroelectric generators and wind turbines. These small-scale renewable systems are distributed over a wide area of PSE's service territory. The median generating capacity of all net metered systems is 5.17 KW. Overall, the program was capable of producing more than 15.8 MW of nameplate capacity at the end of 2014.

Customer preference along with state and federal incentives continues to drive customer solar PV adoption. Residential customers were 92 percent of all solar PV by number and 82 percent by nameplate capacity. PSE introduced a new streamlined solar application in 2014 and continues to prepare for growth in customer generation.

Figure D-15: Interconnected System Capacity by Type of System

System Type	Number of Systems	Average Capacity per System Type (KW)	Sum of all Systems by Type (KW)
Hybrid: solar/wind	12	8.76	105.07
Micro hydro	4	3.30	13.20
Solar array	2,530	6.16	15,575.61
Wind turbine	32	3.23	103.30
Total	**2,578**	**6.13**	**15,797.18**

Figure D-16: Net Metered Systems by County

County	Number of Net Meters
Whatcom	482
King	822
Skagit	238
Island	174
Kitsap	353
Thurston	340
Kittitas	73
Pierce	96
Total	**2,578**

RENEWABLE ENERGY COST RECOVERY. In 2005, in response to Washington Administrative Code (WAC) 458-20-273, PSE launched a renewable energy production incentive payment program under tariff Schedule 151. The program is voluntary for Washington state utilities, but we embraced the opportunity to participate because we have such a large and committed group of interconnected customers. Under this program, PSE makes payments to interconnected electric customers who own and operate eligible renewable energy systems which include solar PV, wind or anaerobic digesters. Average annual credits range from $0.12 to $1.08 per kWh of energy produced by their system. PSE receives a state tax credit equal to the payments made to customers. By the end of 2014, PSE had paid $3,130,000 to 2,000 customers eligible for production payments.

ELECTRIC RESOURCE ALTERNATIVES

This overview of technology alternatives for electric power generation describes both mature technologies and new methods of power generation, including near- and mid-term commercial viability. Within each section, resources are listed alphabetically.

PSE continues to explore emerging resources. This IRP includes an analysis of battery and pumped energy storage (see Appendix L, Electric Energy Storage), an analysis of the impact of high levels of rooftop solar generation at the circuit level and an analysis of the maximum amount of rooftop solar PV that could be installed in PSE's service territory (see Appendix M, Distributed Solar).

Generic Resource Costs and Characteristics

Figure D-17, next page, summarizes the generic thermal resources modeled by PSE. All costs are in 2014 dollars.

Figure D-17: Generic Resource Thermal Assumptions Modeled

2014 dollars	Units	CCCT	Frame Peaker w/ Oil	Frame Peaker w/o Oil	Aero Peaker w/ Oil	Aero Peaker w/o Oil	Recip Peaker
ISO Capacity[1]	MW	317	224	224	207	207	220
Winter Capacity[2]	MW	335	228	228	203	203	220
Capacity Duct Fired unit	MW	50					
Capital Cost	$/kW	$1,256	$896	$830	$1,342	$1,273	$1,599
O&M Fixed	$/kW-yr	$10.55	$17.05	$7.25	$16.23	$7.24	$5.31
O&M Variable	$/MWh	$2.96	$2.69	$2.69	$3.50	$3.50	$8.63
Forced Outage Rate	%	3%	3%	3%	3%	3%	3%
Operating Reserves	%	3%	3%	3%	3%	3%	3%
Heat Rate – Baseload HHV	Btu/kWh	6,798	10,046	10,046	9,156	9,156	8,538
Heat Rate – Turndown HHV	Btu/kWh	7,396	14,115	14,115	11,122	11,122	9,431
Heat Rate Duct Fired unit	Btu/kWh	8,670					
Minimum Capacity[3]	%	50%	40%	40%	25%	25%	4%
Start Time	Minutes	60	29	29	10	10	10
Location[4]		PSE	PSE	PSE	PSE	PSE	PSE
Fixed Gas Transport	$/kW-yr	$63.35	$48.74	$93.62	$44.42	$85.32	$79.57
Variable Gas Transport	$/MMBtu	$0.04	$0.28	$0.04	$0.28	$0.04	$0.04
Fixed Transmission[4]	$/kW-yr	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Variable Transmission[4]	$/MWh	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Emissions[5]							
NO_x	lbs/MMBtu	0.01	0.01	0.01	0.01	0.01	0.02
SO_2	lbs/MMBtu	0.006	0.006	0.006	0.006	0.006	0.03
CO_2	lbs/MMBtu	116.0	112.5	112.5	116.0	116.0	114.7
First Year Available		2020	2019	2019	2019	2019	2019
Economic Life	Years	35	35	35	35	35	35
Greenfield Development[6] & Construction Lead time	Years	4	3	3	3	3	3

NOTES
1 "ISO" capacities represent the operational capacities at International Standard Organization conditions.
2 Winter capacity represents the operational capacity at 23 degrees Fahrenheit.
3 An aeroderivative turbine may run at a minimum capacity of 50%. The generic resource includes two turbines, so the minimum capacity is one unit at 50%, which is equivalent to 25% of two units. Reciprocating turbines may also run at a minimum capacity of 50%. The generic resource includes 12 turbines, which is equivalent to 4% of the capacity of twelve turbines.
4 The location "PSE" means that the plants are located in the PSE service territory with no fixed or variable transmission costs.
5 Emission rates for natural gas only.
6 New power plant built from scratch on undeveloped land.

The fixed and variable gas transport costs for the gas plants are based on purchasing gas at the Sumas Hub. The transport costs for a resource without oil backup are based on needing 100 percent firm gas pipeline transport capacity plus 20 percent in gas storage. This applies to the CCCT, frame peaker without oil, Aero peaker without oil and the reciprocating engine. We are assuming 100 percent firm gas pipeline on a Williams Northwest Pipeline (NWP) expansion to Sumas, plus 100 percent firm gas pipeline on a Westcoast Energy Inc. (Westcoast) gas pipeline expansion to Station 2, and 20 percent of the daily need in gas storage. For the resources with oil backup, the frame and Aero peakers, we are assuming we need 50 percent firm gas pipeline transport on a NWP expansion to Sumas and 50 percent firm gas pipeline transport on a Westcoast pipeline expansion to Station 2, plus 20 percent in gas storage.

Figure D-18 below shows the gas transport assumptions for resources with and without oil backup.

Figure D-18: Gas Transport Costs

CCCT & Peakers without Oil Backup – 100% Sumas on NWP + 100% Station 2 on Westcoast

Pipeline/Resource	Fixed Demand ($/Dth/Day)	Variable Commodity ($/Dth)	ACA Charge ($/Dth)	Fuel Use (%)	Utility Taxes (%)
NWP Expansion	0.560	0.030	0.0018	1.9%	3.852%
Westcoast Expansion	0.460	0.010	-	1.6%	3.852%
Gas Storage	0.044	-	-	2.0%	3.852%
Total	**1.064**	**0.040**	**0.0018**	**5.5%**	**3.852%**

Peakers with Oil Backup – 50% Sumas on NWP + 50% Station 2 on Westcoast

Pipeline/ Resource	Fixed Demand ($/Dth/Day)	Variable Demand ($/Dth)	Variable Commodity ($/Dth)	ACA Charge ($/Dth)	Fuel Use (%)	Utility Taxes (%)
NWP Expansion	0.280	0.131	0.030	0.0018	1.9%	3.852%
Westcoast Expansion	0.230	0.110	0.010	-	1.6%	3.852%
Gas Storage	0.044	-	-	-	2.0%	3.852%
Total	**0.554**	**0.242**	**0.040**	**0.0018**	**5.5%**	**3.852%**

As discussed in Chapter 4, one of the sensitives for the electric portfolio is to test the location of the natural gas plants. The baseline assumption is that the plants are located in the PSE service territory and therefore have zero transmission costs. The “gas plant location” sensitivity is that the plants will be located in eastern Washington, within BPA’s Balancing Authority (BA) and will therefore, require BPA firm Point-to-Point transmission service at a cost of $17.75 per kW per year in 2014 dollars. The plants will also get natural gas from AECO, via the NOVA, Foothills and GTN pipelines. Figure D-19 below displays the gas pipeline costs for a plant in eastern Washington.

Figure D-19: Gas Transport Costs for Eastern Washington

CCCT & Peakers with No Oil Backup – 100% AECO on GTN/NOVA/Foothills

Pipeline/Resource	Fixed Demand ($/Dth/Day)	Variable Commodity ($/Dth)	ACA Charge ($/Dth)	Fuel Use (%)	Utility Taxes (%)
NOVA	0.170	-	-	1.10%	3.852%
Foothills	0.097	0.0	-	1.39%	3.852%
GTN	0.160	0.004	0.0018	2.00%	3.852%
Gas Storage	0.044	-	-	-	3.852%
Total	**0.470**	**0.004**	**0.0018**	**4.49%**	**3.852%**

Peakers with Oil Backup – 50% AECO on GTN/NOVA/Foothills

Pipeline/ Resource	Fixed Demand ($/Dth/Day)	Variable Demand ($/Dth)	Variable Commodity ($/Dth)	ACA Charge ($/Dth)	Fuel Use (%)	Utility Taxes (%)
NOVA	0.085	0.050	-	-	1.10%	3.852%
Foothills	0.049	0.026	-	-	1.39%	3.852%
GTN	0.080	0.048	0.004	0.0018	2.00%	3.852%
Gas Storage	0.044	-	-	-	-	3.852%
Total	**0.257**	**0.124**	**0.004**	**0.0018**	**4.49%**	**3.852%**

Thermal Resources Modeled

Natural Gas. Additional long-term coal-fired generation is not a resource alternative, because RCW 80.80 precludes utilities in Washington from entering into new long-term agreements for coal. New large-scale hydro projects are not practical to develop today, as discussed below. New nuclear generation is neither practical nor feasible. Therefore, natural gas generation is extensively modeled in this IRP analysis due to the following characteristics.

- **Proximity.** Gas-fired generators can often be located within or adjacent to PSE's service area, thereby avoiding costly transmission investments required for long-distance resources like coal or wind.
- **Timeliness.** Gas-fired resources are dispatchable, meaning they can be turned on when needed to meet loads, unlike "intermittent" resources that generate power sporadically such as wind, solar and run-of-the-river hydropower.
- **Versatility.** Gas-fired generators have varying degrees of ability to ramp up and down quickly in response to variations in load and/or wind generation.
- **Environmental Burden.** Natural gas resources produce significantly lower emissions than coal resources (approximately half the CO_2).

Gas storage and fuel supply become increasingly important considerations as reliance on natural gas grows, so the analysis also includes gas storage for some resources. The three types of gas-fired generators modeled in this analysis are described below. Each brings particular strengths into the overall portfolio.

COMBINED-CYCLE COMBUSTION TURBINES (CCCT). Combined-cycle combustion turbine power plants consist of one or more combustion turbine generators equipped with heat recovery steam generators that capture heat from the combustion turbine (CT) exhaust. This otherwise wasted heat is then used to produce additional electricity via a steam turbine generator. Many plants also feature "duct firing." Duct firing can produce additional capacity from the steam turbine generator, although at less efficiency than the primary unit. CCCT plants currently entering service can convert about 60 percent (HHV[9]) of the chemical energy of natural gas into electricity. Because of their high thermal efficiency and reliability, relatively low initial cost and low air emissions, CCCTs have been a popular source of electric power and process steam generation since the 1960s.

9 / Higher Heating Value (HHV) is determined at a standard temperature of 59 degrees Fahrenheit.

This technology is commercially available. Greenfield development requires approximately four years.

Natural gas supply is assumed to be firm year-round and based on projected gas pipeline firm rates. The unit is assumed to be connected to the PSE transmission system and as such does not incur any direct transmission cost. This analysis assumes 20 percent of gas storage is available to the CCCT plants modeled.

SIMPLE-CYCLE COMBUSTION TURBINES (SCCT). There are two principal types of simple-cycle combustion turbines for "peaking" applications: frame and aeroderivative (aero) engines.

Frame CT Peakers. Frame CT peakers are also known as "industrial" or "heavy-duty" CTs; these are generally larger in capacity and feature frames, bearings and blading of heavier construction. Conventional frame CTs are a mature technology. They can be fueled by natural gas, distillate oil or a combination of fuels (dual fuel). Typical units have efficiencies in the range of 30 percent to 40 percent (HHV) at full load. These units are typically less flexible than aeroderivative turbines and reciprocating engines, meaning they cannot reduce output beyond about 40 percent. They also have slower ramp rates (on the order of 20 MW/minute), and though some can start in ten minutes, the output achieved in ten minutes is typically not baseload and incurs a significant maintenance penalty for each ten-minute start.

Frame CT peakers are commercially available. Greenfield development requires approximately three years.

Aeroderivative (Aero) Peakers. Aeroderivative combustion turbines are a mature technology, however, new aeroderivative features and designs are continually being introduced. They can be fueled by natural gas, oil or a combination of fuels (dual fuel). Typical aero units have efficiencies in the range of 25 percent to 38 percent (HHV) at full load. Aero units are typically more flexible than their frame counterparts and many can reduce output to nearly 50 percent. Most can start and achieve full output in less than ten minutes and start multiple times per day without maintenance penalties. Ramp rates range from 20 to 90 MW per minute. Another key difference between aero and frame units is size. Aero CTs are typically smaller in size, from 5 to 100 MW each. This small scale allows for modularity, but it also tends to reduce economies of scale.

This technology is commercially available. Greenfield development requires approximately three years.

RECIPROCATING ENGINES (RECIP PEAKERS). The reciprocating engine technology evaluated is based on a four-stroke spark-ignited gas engine which uses a lean burn method to generate power. The lean burn technology uses a relatively higher ratio of oxygen to fuel, which allows the reciprocating engine to generate power more efficiently. Lean burn reciprocating engines typically show HHV efficiencies in the range of 30 percent to 40 percent while some newer units claim efficiencies as high as nearly 50 percent. However, reciprocating engines are constrained by their size. The largest commercially available reciprocating engine for electric power generation produces 18 MW, which is less than the typical frame or aero turbine. Larger sized generation projects would require a greater number of reciprocating units compared to an equivalent-sized project implementing either an aero or frame turbine, reducing economies of scale. A greater number of generating units increases the overall project availability and reduces the impact of a single unit out of service for maintenance. Reciprocating engines are more efficient than simple-cycle combustion turbines, but have a higher capital cost. Their small size allows a better match with peak loads thus increasing operating flexibility relative to simple-cycle combustion turbines.

This technology is commercially available. Greenfield development requires approximately three years.

Thermal Resources Not Modeled

Coal. Coal fuels a significant portion of the electricity generated in the United States. Most coal-fired electric generating plants combust the coal in a boiler to produce steam that drives a turbine-generator. A small number of plants gasify coal to produce a synthetic gas that fuels a combustion turbine. Of the fuels commonly used to produce electricity, coal produces the most greenhouse gases (GHGs) per MWh of electricity. Technologies for reducing or capturing some of the GHGs produced are currently in the research and development phase.

Commercial availability. New coal-fired generation is not a resource alternative for PSE, because RCW 80.80 sets a generation performance standard for electric generating plants that prohibits Washington utilities from building plants or entering into long-term electricity purchase contracts from units that emit more than 970 pounds of GHGs per MWh.[10] With currently available technology, coal-fired generating plants produce GHGs, primarily carbon dioxide, at a level two or more times greater than the performance standard; and carbon capture and sequestration technology is not yet effective or affordable enough to significantly reduce those levels.

There are no new coal-fired power plants under construction or development in the Pacific Northwest.

Nuclear.

Capital and operating costs for nuclear power plants are so much higher than most conventional and renewable technologies that only a handful of the largest capitalized utilities can realistically consider this option. In addition, nuclear power also carries significant technology, credit, permitting, policy and waste disposal risks.

Cost assumptions. There is little hard data on recent U.S. nuclear developments from which reasonable cost estimates can be made. The construction costs track record for nuclear plants completed in the U.S. during the 1980s and 1990s was certainly poor. Actual costs were far higher than projected, construction schedules experienced long delays, and interest rate increases resulted in high financing charges. Changing regulatory requirements also contributed to project cost increases, and in some instances public controversy contributed to construction delays and cost overruns.

The high cost and high uncertainty of nuclear technology make it an undue risk for PSE at this time.

An extensive discussion of then-existing U.S. nuclear facilities, decommissioning activities, new construction projects and policy considerations was provided in Appendix D of PSE's 2013 IRP.

10 / To support a long-term plan to shut down the only coal-fired generating plant in Washington state, state government has made an exception for transition contracts with the Centralia generating plant through 2025.

Energy Storage Resources Modeled

Figure D-20: Energy Storage Assumptions Modeled

2014 dollars	Units	Battery	Pumped Hydro
Power	MW	80	200
Energy	MWh	160	2000
Discharge at Nominal Power	Hours	2	10
Round-trip Efficiency[1]	%	85%	81%
Recharge at Nominal Power	Hours	2.35	12.42
Station Footprint	Acres	1.5	Big
Capital Cost	$000	$121,277	$480,000
Capital Cost per kW	$/kW	$1,516	$2,400
Capital Cost per kWh	$/kWh	$758	$240
Fixed O&M	$/kW-yr	$7.71	$15.00
Variable O&M	$/MWh	-	-
Forced Outage Rate	%	0.5%	-
Capacity Credit	%	100%	100%
Book Life	Years	20	60
Greenfield Development & Construction Lead time	Years	3	15

NOTES
1 Round-trip efficiency means the percentage of energy input that is available for output.

Electric energy storage technologies are improving rapidly, and this IRP includes a portfolio sensitivity that tests the cost difference between a portfolio that includes battery storage and one that does not. In addition, PSE has designed a pilot project of battery storage to more fully assess the multiple values that storage systems may provide. The study is being done in partnership with the Washington State Department of Commerce and Pacific Northwest National Laboratories. Appendix L, Electric Energy Storage, describes the project in Glacier, Wash.

Renewable Resources Modeled

Figure D-21: Generic Resource Renewable Assumptions Modeled

2014 dollars	Units	Wind	MT Wind	Biomass	Solar
Nameplate Capacity	MW	100	100	15	20
Winter Capacity	MW	8	55	0	0
Capital Cost	$/kW	$1,968	$4,659	$4,322	$2,535
O&M Fixed	$/kW-yr	$27.12	$27.12	$110.98	$17.47
O&M Variable	$/MWh	$3.15	$3.15	$5.53	$0.00
Capacity Factor	%	34%	41%	85%	20%
Capacity Credit	%	8%	55%[11]	0%	0%
Location		SE WA	Central MT	West WA	Central WA
Fixed Transmission	$/kW-yr	$35.23	$55.05	$20.83	$23.35
Variable Transmission	$/MWh	$1.84	$1.84	$0.34	$1.84
First Year Available		2019	2020	2019	2019
Economic Life	Years	25	25	35	25
Greenfield Development & Construction Lead time	Years	3	3	3	3

Biomass. Biomass in this context refers to the burning of woody biomass in boilers. Most existing biomass in the Northwest is tied to steam hosts (also known as “cogeneration” or “combined heat and power”). It is found mostly in the timber, pulp and paper industries. This dynamic has limited the size of power available to date. The typical plant size we have observed is 10 MW to 50 MW. One major advantage of biomass plants is that they can operate as a baseload resource. Also, they do not impose generation variability on the grid, unlike wind and solar. Municipal solid waste, landfill and wastewater treatment plant gas are discussed in the section on waste-to-energy technologies.

Commercial availability. This technology is commercially available. Greenfield development of a new biomass facility would require approximately four years. The costs modeled in Figure D-21 above are from the biomass section of the U.S. Energy Information Administration report, Capital Cost for Electricity Plants (http://www.eia.gov/forecasts/capitalcost/).

11 / This highly optimistic capacity contribution is based on a limited data set. A more comprehensive analysis of an actual wind farm/contract in an acquisition analysis would probably illustrate a lower capacity contribution, but PSE used this value in its analysis.

Solar. Solar energy uses the light and radiation from the sun to directly generate electricity with photovoltaic (PV) technology, or to capture the heat energy of the sun for either heating water or for creating steam to drive electric generating turbines. The solar energy resource modeled in this IRP portfolio sensitivity uses fixed tilt PV technology. For this IRP, PSE has also studied the impact of large amounts of solar energy at the circuit level; see Appendix M, Distributed Solar, for a description of the study and its results.

PHOTOVOLTAICS are semiconductors that generate direct electric currents. The current then typically runs through an inverter to create alternating current, which can be tied into the grid. Most photovoltaic solar cells are made from silicon imprinted with electric contacts; however, other technologies, notably several chemistries of thin-film photovoltaics, have gained substantial market share. Significant ongoing research efforts continue for all photovoltaic technologies, which has helped to increase conversion efficiencies and decrease costs. Photovoltaics are installed in arrays that range from a few watts for sensor or communication applications, up to hundreds of megawatts for utility-scale power generation. PV systems can be installed on a stationary frame at a tilt to best capture the sun (fixed tilt) or on a frame than can track the sun from sunrise to sunset.

CONCENTRATING PHOTOVOLTAICS use lenses to focus the sun's light onto special, high-efficiency photovoltaics, which creates higher amounts of generation for the given photovoltaic cell size. The use of concentrating lenses requires that these technologies be precisely oriented towards the sun, so they typically require active tracking systems.

SOLAR THERMAL PLANTS focus the direct irradiance of the sun to generate heat to produce steam, which in turn drives a conventional turbine generator. Two general types are in use or development today, trough-based plants and tower-based plants. Trough plants use horizontally mounted parabolic mirrors or Fresnel mirrors to focus the sun onto a horizontal pipe that carries water or a heat transfer fluid. Tower plants use a field of mirrors that focus sunlight onto a central receiver. A heat transfer fluid is used to collect the heat and transfer it to make steam.

As of the third quarter of 2014, cumulative solar PV capacity reached 16.1 gigawatts and cumulative concentrating solar power capacity reached 1.4 GW.[12]

12 / Solar Electric Industry Association (SEIA), Q3 2014 Solar Market Insight Report, December 17, 2014.

Commercial availability. Currently, renewable portfolio standards (RPS) drive most utility-scale solar development in the United States. With less sunlight than other areas of the country and incentive structures that limit development to smaller systems, photovoltaic development has been relatively slow in the Northwest. California continues to be the U.S. leader with 642 MW_{dc}[13] of combined residential, non-residential and utility-scale solar PV installations as of September 2014.[14]

Likewise, concentrating PV and concentrating solar thermal systems have not been developed in the Northwest, primarily because of the relatively low irradiance and low market power prices. However, several thermal solar facilities have become operational in California in recent years, including the Ivanpah Solar Electric Generating System, a $2.2 billion project in California's Mojave Desert. In September 2013, NRG Solar announced that Unit 1 of Ivanpah's planned three-unit system had successfully synchronized to the power grid for the first time, producing the facility's first energy output. When all three units are online, the 377 MW facility jointly owned by NRG Energy, BrightSource Energy and Google will be the largest solar thermal facility in the world. It is expected to nearly double the amount of commercial solar thermal capacity now operating in the U.S.[15]

While there are no customer or utility-scale solar thermal installations in Washington state, such facilities have proven reliable over time; thermal solar energy generating systems have been operating successfully in California since the 1980s.

Cost and performance assumptions. With a service area that crosses the Cascade Mountains, PSE saw a large range of customer solar production in 2014. Customer average PV production west of the Cascade Mountains was 982 kWh per KW. Systems in Kittitas County produced roughly 50 percent more, for a total of 1,473 kWh per KW for the year, meaning that PV systems in western Washington had a capacity factor of approximately 11 percent, while those in eastern Washington performed at 17 percent.

Since PSE built the Wild Horse Solar Demonstration Project in 2007, installed costs for PV solar systems have declined considerably. The Solar Electric Industry Association reported that by the third quarter of 2014, national averages had reached approximately \$3.60 per $Watt_{dc}$ for residential systems, \$2.27 per $Watt_{dc}$ for commercial systems and \$1.88 per $Watt_{dc}$ for utility-scale single-axis tracking systems.[16]

13 / Solar is installed at direct current (dc).
14 / Solar Electric Industry Association (SEIA), Q3 2014 Solar Market Insight Report, December 17, 2014.
15 / Brightsource Energy website. Retrieved from http://www.ivanpahsolar.com/news-releases, September 2013.
16 / Solar Electric Industry Association (SEIA), Q3 2014 Solar Market Insight Report, December 17, 2014.

The EIA in its *Annual Energy Outlook 2014* estimates capital costs for utility-scale PV solar systems to be approximately \$3,564 per KW_{ac}[17] and solar thermal plants to be approximately \$5,045 per KW_{ac}. This is on the higher end of cost estimates. Many resources in the western United States are seeing costs around \$2,600 per KW_{ac}.

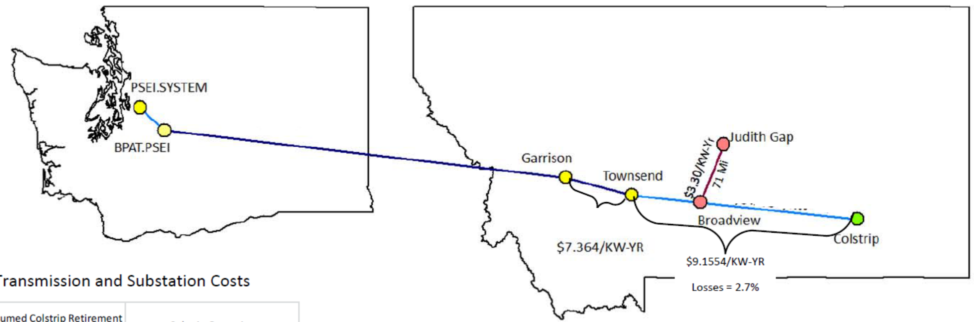
Wind. Wind energy is the primary renewable resource that qualifies to meet RPS requirements in our region due to wind's technical maturity, reasonable lifecycle cost, acceptance in various regulatory jurisdictions and large "utility" scale compared to other technologies. However, it also poses challenges. Because of its variability, wind's daily and hourly power generation patterns don't necessarily correlate with customer demand; therefore, more flexible thermal and hydroelectric resources must be standing by to fill the gaps. This variability also makes it challenging to integrate into transmission systems. Finally, because wind projects are often located in remote areas, they frequently require long-haul transmission on a system that is already crowded and strained.

WASHINGTON WIND VS. MONTANA WIND. For this IRP, wind was modeled in two locations, southeast Washington and central Montana. Washington wind is located in BPA's BA, so this wind only requires one transmission wheel through BPA to PSE. Montana wind, however, is outside BPA's BA and will require four transmission wheels plus various system upgrades to deliver the power to PSE service territory; the Judith Gap location was chosen because PSE was able to obtain data from that wind project for use in the analysis.

Figures D-22 through D-25 explain the two sets of costs and assumptions used in this IRP analysis to examine Washington vs. Montana wind resources. PSE's original baseline assumptions are presented in Figures D-22 and D-23. When this material was discussed in the IRPAG, the group made a number of suggestions intended to help reduce the cost of Montana wind. PSE worked with an IRPAG member to create the second set of assumptions and scenarios summarized in Figures D-24 and D-25.

17 / *PSE models generic solar resources as alternating current (ac) to recognize the cost of the conversion from dc to ac.*

Figure D-22: Washington vs. Montana Wind, PSE Baseline Assumptions



Transmission and Substation Costs

Assumed Colstrip Retirement Colstrip Operating	Colstrip Operating
A) $32.4 Million- Upgrade JG-Broadview Line	C) $662 Million- Upgrade JG-Broadview Line + Expand Broadview Sub + New Broadview-Garrison Line + Expand Garrison Sub
B) $94.2 Million- New JG-Broadview Line + Broadview Sub. Upgrade	D) $724 Million- New JG-Broadview Line + Expand Broadview Sub + New Broadview-Garrison Line + Expand Garrison Sub

*Right Of Way costs are not included in estimate of new transmission lines
*Assuming plant size of 265 MWs
*Costs only reflect additional substation/transmission equipment does not include transmission wheeling or cost to build wind facility
*Overheads not included

Wind Capacity	Percentage	
MT Wind Capacity Factor		41.00%
Loss Factor		6.70%
Wind Capacity Net of Losses		38.30%
Transmission Costs	**$/KW-Year**	
Judith Gap to Broadview	$	3.3000
Broadview to Townsend	$	9.1550
Townsend to Garrison	$	7.3640
Total	**$**	**19.8190**
$/MWh	**$**	**5.5200**

The baseline costs for transmission of wind power from Montana can be broken down into two main categories.

1. Colstrip retires, making capacity available on the existing Colstrip transmission line.
2. Colstrip does not retire, and various lines and systems will need to be upgraded to provide the additional capacity required for wind transmission.

Figure D-23: PSE Wind Scenarios, 2015 IRP

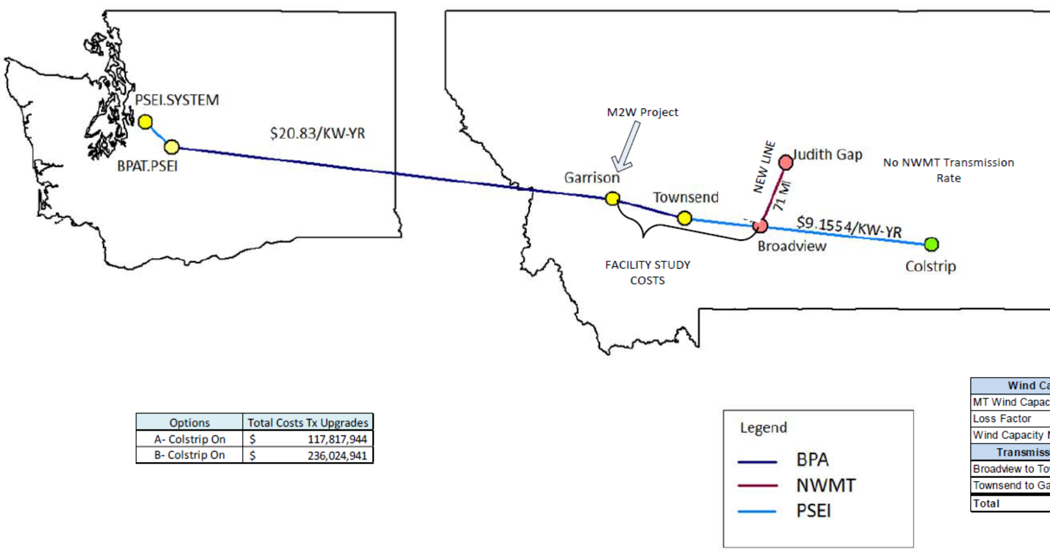
Name	Total Cost	Assumptions	Cost Breakdown Per Assumption
PSE Scenario A	$32.4 million	1. Colstrip is retired	
		2. Upgrade transmission line from Judith Gap to Broadview	$ 32,453,878
		Total PSE A:	*$ 32,453,878*
PSE Scenario B	$94.2 million	1. Colstrip is retired	
		2. Build new transmission line from Judith Gap to Broadview	$ 92,725,365
		3. Upgrade Broadview substation	$ 1,492,903
		Total PSE B:	*$ 94,218,268*
PSE Scenario C	$662 million	1. Colstrip is operating	
		2. Upgrade transmission line from Judith Gap to Broadview	$ 32,453,878
		3. Upgrade Broadview substation	$ 10,889,286
		4. New line required from Broadview to Garrison	$ 604,625,490
		5. Garrison substation expansion required	$ 14,512,836
		Total PSE C:	*$ 662,481,489*
PSE Scenario D	$723 million	1. Colstrip is operating	
		2. Build new transmission line from Judith Gap to Broadview	$ 92,725,365
		3. Upgrade Broadview substation	$ 10,889,286
		4. New line required from Broadview to Garrison	$ 604,625,490
		5. Garrison substation expansion required	$ 14,512,836
		Total PSE D:	*$ 722,752,976*

Wind Capacity	Percentage
MT Wind Capacity Factor	41.00%
Loss Factor	5.70%
Wind Capacity Net of Losses	35.30%
Transmission Costs	**$/KW-Year**
Broadview to Townsend	$ 9.1550
Townsend to Garrison	$ 7.3640
Total	**$ 16.5190**

To determine the appropriate costs to model in the IRP, PSE developed four different scenarios. These are labeled A through D on Figure D-22 above, and summarized in the table below.

For the purposes of this IRP, PSE Scenario C was modeled as the baseline. Scenario A was modeled under the Colstrip retirement scenario.

Figure D-24: Washington vs. Montana Wind Assumptions, per IRPAG Input



Options	Total Costs Tx Upgrades
A- Colstrip On	$ 117,817,944
B- Colstrip On	$ 236,024,941

Wind Capacity	Percentage
MT Wind Capacity Factor	41.00%
Loss Factor	5.40%
Wind Capacity Net of Losses	38.79%
Transmission Costs	**$/KW-Year**
Broadview to Townsend	$ 9.1550
Townsend to Garrison	$ 7.3640
Total	**$ 16.5190**

Per Figure D-24, two scenarios were developed using the IRPAG inputs.

Figure D-25: IRPAG Wind Scenarios

Name	Cost	Assumptions	Cost Breakdown Per Assumption
IRPAG Scenario A	$117 million	1. Colstrip is operating	
		2. New line from Judith Gap to Broadview substation (wood poles)	$ 37,995,039
		3. Broadview substation upgrades to accommodate additional line	*$ 1,492,903*
		4. Fiber for communications	$ 5,317,512
		5. NWMT Facility Study – Upgrades required from Broadview to Garrison (provided by Bill Pascoe)	$ 73,012,490
		6. BPA recovers in transmission rate the Montana to Washington project (totally $153 Million dollars, this scenario assumes $0)	$ -
		Total IRPAG Scenario A:	*$ 117,817,944*
IRPAG Scenario B	$236 million	1. Colstrip is operating	
		2. New line from Judith Gap to Broadview substation (wood poles)	$ 37,995,039
		3. Broadview substation upgraded to accommodate additional line	$ 1,492,903
		4. Fiber for communications	$ 5,317,512
		5. NWMT Facility Study – Upgrades required from Broadview to Garrison (provided by Bill Pascoe)	$ 73,012,490
		6. PSE would have to cover 77.26% of the Montana to Washington project (if PSE placed their transmission requests into the BPA queue today, this is the percentage of the total amount of MWs forcing the project to be built that would be PSE's portion).	$ 118,206,997
		Total IRPAG Scenario B:	*$ 236,024,941*

Wind Capacity	Percentage
MT Wind Capacity Factor	41.00%
Loss Factor	5.40%
Wind Capacity Net of Losses	38.79%
Transmission Costs	**$/KW-Year**
Broadview to Townsend	$ 9.1550
Townsend to Garrison	$ 7.3640
Total	**$ 16.5190**

The Montana transmission estimates that the IRPAG helped provide input on were used as a sensitivity, since the cost anaylsis was completed too late to be used in portfolio modeling. There are many unknowns with the Montana transmission system. Because a majority of the constrained paths are owned and operated by either BPA or Northwestern Energy, PSE's visibility is limited, which makes cost estimating difficult to complete. From various BPA meetings and PSE's experience with the West of Garrison flowgate, the transmission system to the west of the Garrison substation is currently at its capacity limit, and any additional capacity would require some type of upgrade to the transmission system. If these scenarios proved to be cost effective in the portfolio anaylsis and PSE wished to pursue the venture further, PSE would begin working with BPA and NWMT to refine the transmission cost estimates.

Wind turbine generator technology is mature and the dominant form of new renewable energy generation in the Pacific Northwest. While the basic concept of a wind turbine has remained generally constant over the last several decades, the technology continues to evolve, yielding larger towers, wider rotor diameters, greater nameplate capacity and increased wind capture (efficiency). Commercially available machines are in the 2.0 to 3.0 MW range with hub heights of 80 to 100[18] meters and blade diameters topping out around 110 meters. These changes have come about largely because development of premium high-wind sites has pushed new development into less-energetic wind sites. The current generation of turbines is pushing the physical limits of existing transportation infrastructure. In addition, if nameplate capacity and turbine size continue to increase, the industry must explore creative solutions, such as concrete tower foundations poured on site.

Commercial availability. The market for turbines appears to be in favor of buyers at the moment. Greenfield development of a new wind facility requires approximately three to five years and consists of the following activities at a minimum: one to two years for development, permitting and major equipment lead-time, and one year for construction.

Cost and performance assumptions. The cost for installing a wind turbine includes the turbine, foundation, roads and electrical infrastructure. Installed cost for a typical facility in the Northwest region is approximately $2,000 per kW. The levelized cost of energy for wind power is a function of the installed cost and the performance of the equipment at a specific site, as measured by the capacity factor. Including operation and maintenance (O&M) costs, the levelized cost of energy ranges from $60 to $100 per MWh.[19] PSE's most recent wind project, the Lower Snake River facility, which was placed in service in February 2012, fits in the high end of this range.

18 / One hundred meters is equivalent to 328 feet which is equivalent to a 30-story building.
19 / Source: 2013 Wind Technologies Market Report, U.S. Department of Energy.

Renewable Resources Not Modeled

Fuel Cells. Fuel cells combine fuel and oxygen to create electricity, heat, water and other byproducts through a chemical process. Fuel cells have high conversion efficiencies from fuel to electricity compared to many traditional combustion technologies, on the order of 25 to 60 percent. In some cases, conversion rates can be boosted using heat recovery and reuse. Fuel cells operate and are being developed at sizes that range from watts to megawatts. Smaller fuel cells power items like portable electric equipment, larger ones can be used to power equipment, buildings, or provide backup power. Fuel cells differ in the membrane materials used to separate fuels, the electrode and electrolyte materials used, operating temperatures and scale (size). Reducing cost and improving durability are the two most significant challenges to fuel cell commercialization. Fuel cell systems must be cost-competitive with, and perform as well as, traditional power technologies over the life of the system.[20]

Provided that feedstocks are kept clean of impurities, fuel cell performance can be very reliable. They are often used as backup power sources for telecommunications and data centers, which require very high reliability. In addition, fuel cells are starting to be used for commercial combined heat and power applications, though mostly in states with significant subsidies or incentives for fuel cell deployment.

Commercial availability. Fuel cells have been growing in both number and scale, but they do not yet operate at large scale. Several megawatt-scale installations are operating in Connecticut, Delaware and California. The two largest fuel cell installations in the United States today are located on the East Coast. One is a 14.9 MW plant, owned by Dominion, located in Bridgeport, Connecticut. The other project consists of blocks of fuel cells installed at two Delmarva Power substations in Delaware that are capable of distributing a combined total of up to 30 MW of electric capacity. In some states, incentives are driving fuel cell pricing economics to be competitive with retail electric prices, especially where additional value can be captured from waste heat. Currently, Washington state offers no incentives specific to fuel cells. The EIA's Annual Energy Outlook 2014 estimates fuel cell capital costs to be approximately $7,044 per KW.

20 / *U.S. Department of Energy, Energy Efficiency and Renewable Energy, Fuel Cell Technologies Program.*

Geothermal. Geothermal generation technologies use the natural heat under the surface of the earth to provide energy to drive turbine generators for electric power production. Geothermal energy production falls into four major types.

DRY STEAM PLANTS use hydrothermal steam from the earth to power turbines directly. This was the first type of geothermal power generation technology developed.[21]

FLASH STEAM PLANTS operate similarly to dry steam plants, but they use low-pressure tanks to vaporize hydrothermal liquids into steam. Like dry steam plants, this technology is best suited to high temperature geothermal sources (greater than 182 degrees Celsius).[22]

BINARY-CYCLE POWER PLANTS can use lower temperature hydrothermal fluids to transfer energy through a heat exchanger to a fluid with a lower boiling point. This system is completely closed-loop, no steam emissions from the hydrothermal fluids are released at all. The majority of new geothermal installations are likely to be binary-cycle systems due to the limited emissions and the greater number of potential sites with lower temperatures.[23]

ENHANCED GEOTHERMAL or "hot dry rock" technologies involve drilling deep wells into hot dry or nearly dry rock formations and injecting water to develop the hydrothermal working fluid. The heated water is then extracted and used for generation.[24]

Geothermal plants typically run with high uptime, often exceeding 85 percent. However, plants sometimes do not reach their full output capacity due to lower than anticipated production from the geothermal resource.

Commercial availability. At the end of 2014 approximately 3.5 GW of geothermal generating capacity was online in the United States,[25] with 96 percent of that capacity in California or Nevada.[26] Operating geothermal plants in the Northwest include the 28.5 MW Neal Hot Springs plant and the 15.8 MW Raft River plant in Idaho.

An estimated 160 MW of planned capacity additions are in some stage of development in the Northwest.[27] These include an expansion of the Raft River project in Idaho and Crump Geyser in Oregon. There are other projects in very early development that have not yet proven their output.

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21 / http://energy.gov/eere/geothermal/electricity-generation
22 / Ibid.
23 / Ibid.
24 / http://energy.gov/sites/prod/files/2014/02/f7/egs_factsheet.pdf
25 / Geothermal Energy Association, 2015 Annual US & Global Geothermal Power Production Report.
26 / Geothermal Energy Association, 2013 Annual US Geothermal Power Production and Development Report
27 / Ibid.

Geothermal energy plants are capital intensive, with estimated capital costs of approximately $6,200 per KW for traditional dual flash geothermal steam plants.[28] Other large-scale technologies, including binary plants, are similar in cost. Overall, site-specific factors including resource size, depth and temperature can significantly affect costs.

Waste-to-energy Technologies. Converting wastes to energy is a means of capturing the inherent energy locked into wastes. Generally, these plants take one of the following forms.

WASTE COMBUSTION FACILITIES. These facilities combust waste in a boiler and use the heat to generate steam to power a turbine that generates electricity. This is a well-established technology, with 86 plants operating in the United States, representing 2,720 MW in generating capacity.[29]

WASTE THERMAL PROCESSING FACILITIES. This includes gasification, pyrolysis and reverse polymerization. These facilities add heat energy to waste and control the oxygen available to break down the waste into components without combusting it. Typically, a syngas is generated, which can be combusted for heat or to produce electricity. A number of pilot facilities once operated in the United States, but only a few remain today.

28 / U.S. Energy Information Administration, Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants, April 2013.
29 / U.S. Environmental Protection Agency website. Retrieved from http://www.epa.gov/waste/nonhaz/municipal/wte/, January 2015.

LANDFILL GAS AND MUNICIPAL WASTEWATER TREATMENT FACILITIES. Most landfills in the United States collect methane from the decomposition of wastes in the landfill. Many larger municipal wastewater plants also operate anaerobic systems to produce gas from their organic solids. Both of these processes produce a low-quality gas with approximately half the methane content of natural gas. This low-quality gas can be collected and scrubbed to remove impurities or improve the heat quality of the gas. The gas can then be used to fuel a boiler for heat recovery, or a turbine or reciprocating engine to generate electricity. There were 636 landfill gas energy projects operating in 48 U.S. states in 2014. According to the U.S. EPA, these facilities combined were capable of providing 15 billion kWh of electricity and 116 billion cubic feet of landfill gas to end users, or enough energy to power more than 1.6 million homes that year.[30]

Commercial availability. Washington's RPS initially included landfill gas as a qualifying renewable energy resource, but excluded municipal solid waste. The passage of ESSB 5575 later expanded the definitions of wastes and biomass to allow some new wastes, such as food and yard wastes, to qualify as renewable energy sources.

Currently, several waste-to-energy facilities are operating in or near PSE's electric service area. Three waste facilities – the H.W. Hill Landfill Gas Project, the Spokane Waste-to-Energy Plant and the BioFuels Washington facility – use landfill gas for electric generation in Washington state; combined, they produce up to 67 MW of electrical output. The H.W. Hill facility in Klickitat County is fed from the Roosevelt Regional Landfill and capable of producing a maximum capacity of 36.5 MW.[31] The Spokane Waste-to-Energy Plant processes up to 800 tons per day of municipal solid waste from Spokane County and is capable of producing up to 26 MW of electric capacity.[32] BioFuels Washington uses landfill gas produced at the LRI Landfill in Pierce County to generate up to 4.5 MW of electricity. The facility became commercially operational in December 2013.[33] PSE purchases the electricity produced by the facility through a power purchase agreement under a Schedule 91 contract, which is discussed above.

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30 / U.S. Environmental Protection Agency website. Retrieved from http://www.epa.gov/lmop/documents/pdfs/green_power_from_landfill_gas.pdf, September 2014.
31 / Phase 1 of the H.W. Hill facility consists of five reciprocating engines, which combined produce 10.5 MW. Phase 2, completed in 2011, adds two 10-MW combustion turbines, and a heat recovery steam generator and steam turbine for an additional 6 MW. Source: Klickitat PUD website. Retrieved from http://www.klickitatpud.com/topicalMenu/about/powerResources/hwHillGasProject.aspx, January 2015.
32 / Spokane Waste to Energy website. Retrieved from http://www.spokanewastetoenergy.com/WastetoEnergy.htm, January 2015.
33 / BioFuels Washington, LLC landfill gas to energy facility solid waste permit (2014-2015) and permit application (2013), as posted to the Tacoma – Pierce County Health Department website. Retrieved from http://www.tpchd.org/environment/waste-management/lri-landfill/biofuels/, January 2015.

The largest landfill in PSE's service territory, the Cedar Hills landfill, currently purifies its gas to meet pipeline natural gas quality; then they sell that gas to PSE rather than using it to generate electricity. The only waste thermal processing facility known in the Northwest is a test facility operated by InEnTec in Richland, Wash. Several wastewater treatment plants in PSE's electric service area use gas from their digestion processes to generate electricity for their facility operations, but typically not enough to make surpluses available to PSE.

No waste-to-energy facilities are currently planned or under construction in the Northwest. However, a third waste combustion facility has been operational in the Northwest since 1987. Covanta's Marion County facility in Brooks, Ore. generates up to 13.1 MW of electricity from a single steam generator. Covanta sells this output to Portland General Electric Company.[34]

Cost and performance assumptions. Relatively few new waste combustion and landfill gas-to-energy facilities have been built since 2010, making it difficult to obtain reliable cost data. The EIA's Annual Energy Outlook 2014 estimates municipal solid waste-to-energy costs to be approximately $8,300 per KW.

In general, waste-to-energy facilities are highly reliable, as they've used proven generation technologies and gained considerable operating experience over the past 30 years. Some variation of output from landfill gas facilities and municipal wastewater plants is expected due to uncontrollable variations in gas production. For waste combustion facilities, output is typically more stable, as the amount of input waste and heat content can be more easily controlled.

34 / Covanta website. Retrieved from http://www.covanta.com/facilities/facility-by-location/marion.aspx,January 2015.

Wave and Tidal. The natural movement of water can be used to generate energy through the flow of tides or the rise and fall of waves.

TIDAL GENERATION TECHNOLOGY uses tidal flow to spin rotors that turn a generator. Two major plant layouts exist: barrages, which use artificial or natural dam structures to accelerate flow through a small area, and in-stream turbines, which are placed in natural channels. The Rance Tidal Power barrage system in France was the world's first large-scale tidal power plant. It became operational in 1966 and has a generating capacity of approximately 240 MW. The Sihwa Lake Tidal Power Station in South Korea is currently the world's largest tidal power facility. The plant was opened in late 2011 and has a generating capacity of approximately 254 MW. Other notably large tidal facilities include the 240 MW Swansea Bay Tidal Lagoon in the United Kingdom, the 86 MW MeyGen Tidal Energy Project in Scotland and the 20 MW Annapolis Royal Generating Station in Nova Scotia, Canada. In-stream turbines up to 1.2 MW in size have been tested in Canada, Scotland and South Korea.[35]

In 2014, the U.S. Navy awarded $8 million to the University of Washington to develop marine energy from tides, currents and waves to help the Navy fulfill its commitment to obtain half of its energy from renewable sources by 2020. According to the university website, this project is in the early stages of exploration and development, with plans to begin testing prototypes and larger scale models over the next couple of years.[36]

WAVE GENERATION TECHNOLOGY uses the rise and fall of waves to drive hydraulic systems, which in turn fuel generators. Technologies tested include floating devices such as the Pelamis and bottom-mounted devices such as the Oyster. The largest wave power plant in the world was the 2.25 MW Agucadoura Wave Farm off the coast of Portugal, which opened in 2008.[37] It has since been shut down because of the developer's financial difficulties. Significant testing has occurred off of Scotland's coast, and developments are underway in Scotland, Australia and England.

35 / Power Technology website. Retrieved from http://www.power-technology.com/features/featuretidal-giants---the-worlds-five-biggest-tidal-power-plants-4211218, April 2014.
36 / University of Washington website. Retrieved from http://www.washington.edu/news/2014/10/24/u-s-navy-awards-8-million-to-develop-wave-tidal-energy-technology/, October 2014.
37 / CNN website. Retrieved from http://www.cnn.com/2010/TECH/02/24/wave.power.buoys/index.html, February 2010.

Commercial availability. Since mid-2013, a number of significant wave and tidal projects and programs have slowed, stalled or shutdown altogether. Bloomberg New Energy Finance reported in August 2014 that Oceanlinx and Wavebob had gone out of business, Wavegen had been absorbed back into its parent company Voith, and both AWS Ocean Energy and Ocean Power Technologies had scaled back activities.[38] In November 2014, Scottish wave power developer Pelamis announced its intention to cease development due to lack of funding.[39] Soon after, energy and technology giant Siemens decided to sell its tidal power business, Marine Current Turbines Ltd., and to close its ocean energy division due to lack of development of the market and supply chain.[40] This was quickly followed in December 2014 by an announcement from Scotland's Aquamarine Power (developer of the Oyster wave machine) that it had decided to significantly downsize, cutting all but a core staff to manage the business and a single machine still operating at the European Marine Energy Centre in Orkney.[41]

Currently, there are no operating tidal energy projects on the West Coast. In late 2014, Snohomish PUD abandoned plans to develop a 1 MW installation at the Admiralty Inlet.[42] Several years ago, Tacoma Power considered and later abandoned plans to pursue a project in the Tacoma Narrows. A small system has been tested off Vancouver Island, B.C, but no further development is planned at this time.

Several sites have been tested for wave power in the Northwest. The Reedsport, Ore. site is the furthest along in development. Current plans call for 10 buoy-type floating tidal power generators, with a combined capacity of 1.5 MW. However, reports of schedule delays in recent years suggest that launch of an initial test buoy is unlikely before at least 2016.[43]

38 / Bloomberg New Energy Finance website. Retrieved from http://about.bnef.com/press-releases/tidal-stream-wave-power-lot-still-prove/, August 2014.
39 / Pelamis website. Retrieved from http://www.pelamiswave.com/news/news/173/Pelamis-Wave-Power-Limited-Pelamis-to-be-put-into-administration, November 2014.
40 / Bloomberg website. Retrieved from http://www.bloomberg.com/news/2014-11-25/siemens-exits-tidal-power-industry-blaming-slow-development.html, November 2014.
41 / Aquamarine Power website. Retrieved from http://www.aquamarinepower.com/news/aquamarine-power-announces-plans-to-downsize-business.aspx, December 2014.
42 / The Seattle Times website. Retrieved from http://seattletimes.com/html/localnews/2024665977_tidalprojectstalled1xml.html, October 2014.
43 / The Oregonian website. Retrieved from http://www.oregonlive.com/environment/index.ssf/2013/08/oregon_wave_energy_stalls_off.html, August 2013-.

In general, the limiting factors in developing wave and tidal power projects have been funding constraints, long and complex permitting process timelines, relatively little experience with siting and the early-stage of the technology's development. FERC oversees permitting processes for tidal power projects, but state and local stakeholders can also be involved. After permits are obtained, studies of the site's water resource and aquatic habitat must be made prior to installation of test equipment.

Few wave and tidal technologies have been in operation for more than a few years and their production volumes are limited, so costs remain high and the durability of the equipment over time is uncertain.

Cost and performance assumptions. Tidal and wave generation technologies are very early in development, making cost estimates difficult. Most developers have not produced more than one full-scale device, and many have not even reached that point.

Wind, Off-shore Generation. Off-shore wind generation uses horizontal-axis wind turbines specifically designed for use in harsh marine environments. Offshore wind resources are abundant, stronger and blow more consistently than land-based wind resources. Data on the resource potential suggest more than 4,000 GW could be accessed in state and federal waters along the coasts of the United States and the Great Lakes, approximately four times the combined generating capacity of all U.S. electric power plants.[44]

Globally, almost 9,000 MW of off-shore wind resources were planned or in operation in Europe, China, Japan and the United Kingdom as of early 2015.[45] The largest offshore wind farm is Walney 1 and 2 located in the Irish Sea in the U.K. The number of people working in the U.K.'s offshore sector grew from 700 in 2007 to around 3,200 in 2011.

Existing offshore wind installations have mainly been located in water depths of less than 30 meters and constructed with driven-pile foundations, though some gravity foundations exist and a number of new designs are under development for tripod platforms and floating platforms. One floating platform wind turbine is currently in operation off Norway.

44 / U.S. Department of Energy Wind Program.
45 / Lindoe Offshore Renewables Center, http://www.lorc.dk/offshore-wind-farms-map/list.

Commercial availability. As of January 2015, there are no operating offshore wind projects in the United States. The U.S. Department of the Interior has begun offering leases to federal acreage off the coasts of Virginia, Massachusetts and Rhode Island for offshore wind farm development. In total, 14 U.S. projects, representing approximately 4.9 GW of potential capacity, can now be considered in advanced stages of development. In the Pacific Northwest region, there is one deep-water project under development in Oregon. The 30 MW Principle Power "Windfloat Pacific" project is currently in the environmental assessment process.[46] The next-nearest project is the Naikun Offshore Wind Project in British Columbia. The 400 MW project has achieved an advanced stage of development and gained environmental approvals from the provincial and federal governments. It is currently seeking a power purchase agreement.

Cost and performance assumptions. Due to sustained winds, off-shore wind is expected to operate at higher capacity factors than land-based wind projects. However, the costs of marine construction and operations considerably exceed those of land-based construction and operation. Since no projects have been successfully developed or constructed in the United States at this time, the capital cost of off-shore wind development is difficult to predict. Estimates indicate these could be at least $4,000 per KW, which is far from competitive with land-based turbines.[47] As a point of reference, the 130-turbine Cape Wind PPA is priced at 18.7¢ per kWh, while the weighted average cost of land-based wind energy is less than 6¢ per kWh.[48] Given this 3x cost differential, off-shore wind energy is simply not cost competitive with land-based developments unless significant technological improvement takes place.

Policy considerations. To encourage development of off-shore wind resources, the Obama administration announced funding in 2012 for seven projects. The Department of Energy says the funding of up to $168 million over six years will expedite development of the nation's first off-shore wind farms. None are operational yet, but 9 have reached the advanced development phase and 24 more are in earlier development stages.

Under the Department of Energy's new funding, which builds upon $42 million in R&D awards given last year, each project will receive up to $4 million to complete engineering, site evaluation and planning. The department will then select up to three of the projects and offer each up to $47 million to facilitate commercial operation by 2017. The seven projects are in six states; the closest to PSE is Principle Power's proposed wind farm off Coos Bay, Ore.

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46 / Offshore Wind Market Analysis: 2014 Market Assessment.
47 / NREL - Large Scale Offshore Wind Power in the United States, Opportunities and Barriers, 2010.
48 / Berkeley Lab, 2011.

Demand-side Resources Modeled

The demand-side resource alternatives considered include the following.

ENERGY EFFICIENCY MEASURES. This label is used for a wide variety of measures that result in a smaller amount of energy being used to do the same amount of work. Among them are building codes and standards that make new construction more energy efficient, retrofitting programs, appliance upgrades, and heating, ventilation and air conditioning (HVAC) and lighting changes.

DEMAND-RESPONSE (DR). Demand-response resources are comprised of flexible, price-responsive loads, which may be curtailed or interrupted during system emergencies or when wholesale market prices exceed the utility's supply cost.

DISTRIBUTED GENERATION. Distributed generation refers to small-scale electricity generators located close to the source of the customer's load.[49]

DISTRIBUTION EFFICIENCY (DE). This involves voltage reduction and phase balancing. Voltage reduction is the practice of reducing the voltage on distribution circuits to reduce energy consumption, as many appliances and motors can perform properly while consuming less energy. Phase balancing eliminates total current flow losses that can reduce energy loss.

GENERATION EFFICIENCY. This involves energy efficiency improvements at the facilities that house PSE generating plant equipment, and where the loads that serve the facility itself are drawn directly from the generator and not the grid. These loads are also called parasitic loads. Typical measures target HVAC, lighting, plug loads and building envelope end-uses.

CODES AND STANDARDS (C&S). No-cost energy efficiency measures that work their way to the market via new efficiency standards that originate from federal and state codes/standards.

49 / In this IRP distributed solar PV is not included in the demand-side resources. Instead, it is handled as a direct no-cost reduction to the customer load. Solar PV subsidies are driving implementation and the subsidies are not fully captured with by the Total Resource Cost (TRC) approach that is used to determine the cost effectiveness of DSR measures. Under the TRC approach, distributed solar PV is not cost effective and so is not selected in the portfolio analysis. Treating solar as a no-cost load reduction captures the adoption of this distributed generation resource by customers and its impact on loads more accurately.

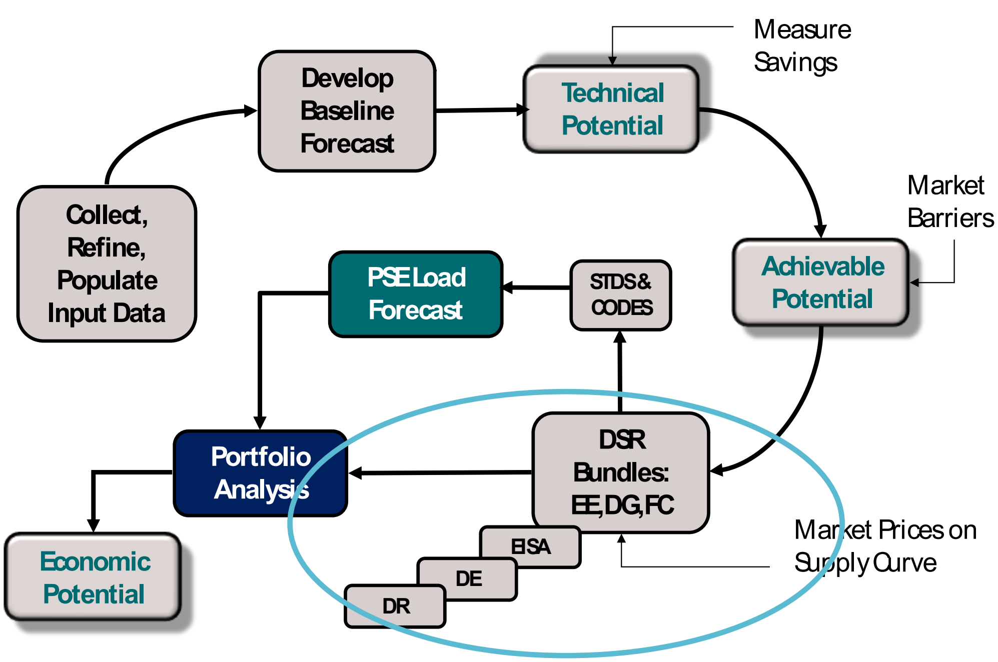
Treatment of Demand-side Resource Alternatives. First, each demand-side measure was screened for technical potential. Screening for technical potential assumed that all energy and demand saving opportunities could be captured regardless of cost or market barriers, so the full spectrum of technologies, load impacts, and markets could be surveyed.

Second, market constraints were applied to estimate the achievable potential. To gauge achievability, we relied on customer response to past PSE energy programs, the experience of other utilities offering similar programs, and the Northwest Power and Conservation Council's most recent energy efficiency potential assessment. For this IRP, PSE assumed achievable electric energy efficiency potentials of 85 percent in existing buildings and 65 percent in new construction.

Finally, the measures were combined into bundles based on levelized cost for inclusion in the portfolio optimization analysis. This methodology is consistent with the methodology used by the Northwest Power and Conservation Council.

Figure D-26 illustrates the methodology PSE used to assess demand-side resource potential in the IRP. Appendix J, Demand-side Resources, contains a detailed discussion of the demand-side resource evaluation and development of the DSR bundles performed for PSE by Cadmus.

Figure D-26: General Methodology for Assessing Demand-side Resource Potential



The following tables summarize the results of the Cadmus analysis of demand-side resources presented in Appendix J. Bundles A through H include energy efficiency, fuel conversion and distributed generation. Each bundle adds measures to the bundle that preceded it.

Figure D-27: Annual Energy Savings (aMW)

	Bundle											
	A	A1	B	B1	C	D	E	F	G	H	DE	C&S
2016	6.8	10.9	12.2	12.7	13.3	13.4	13.9	14.0	14.9	18.9	0.3	12.8
2017	22.7	35.7	39.4	41.1	43.1	43.7	45.2	45.5	48.5	61.2	0.9	33.4
2018	40.1	64.3	70.4	73.4	77.6	78.8	81.7	82.3	87.3	109.5	1.5	45.1
2019	55.8	92.2	102.4	106.8	113.5	115.3	119.8	120.9	128.0	159.8	2.2	55.3
2020	69.3	118.5	133.0	139.1	148.9	151.4	157.7	159.3	168.7	210.4	2.8	70.7
2021	81.2	143.0	160.5	168.3	181.6	184.9	193.1	195.4	206.9	258.6	3.4	86.8
2022	93.2	166.8	188.4	198.0	215.0	219.2	229.4	232.4	246.1	308.2	4.1	95.1
2023	105.2	190.3	215.9	227.2	248.0	253.0	265.1	268.8	284.7	358.1	4.7	102.9
2024	117.7	214.4	243.2	256.2	280.7	286.4	300.4	304.7	322.7	408.7	5.4	111.2
2025	129.4	236.5	268.3	282.9	311.0	317.5	333.3	338.0	358.2	455.7	6.1	117.6
2026	137.4	252.1	285.7	301.5	332.8	339.8	356.9	362.0	383.4	489.7	6.9	123.2
2027	140.9	260.0	294.1	310.8	344.6	351.9	370.4	375.6	397.1	509.2	7.9	128.2
2028	144.8	268.5	303.1	320.8	357.1	364.6	385.2	390.6	412.2	530.5	9.0	133.6
2029	148.3	276.1	311.2	329.6	368.4	376.2	398.4	403.9	425.6	551.2	10.0	138.8
2030	152.1	284.1	319.7	339.0	380.2	388.3	412.0	417.7	439.6	574.4	11.0	143.4
2031	155.7	291.9	327.9	348.0	393.3	401.7	427.1	432.9	454.9	599.0	12.0	147.5
2032	159.9	300.9	337.5	358.5	409.5	418.3	445.5	451.4	473.7	627.8	13.2	151.9
2033	162.9	307.5	344.3	365.9	421.8	430.9	459.4	465.3	487.7	649.2	14.2	155.1
2034	166.4	315.0	352.3	374.5	435.3	444.7	474.5	480.5	503.0	671.8	15.3	158.4
2035	170.2	323.1	360.8	383.7	448.9	458.7	489.6	495.7	518.3	693.9	16.5	162.1

Figure D-28: Total December Peak Reduction (MW)

	Bundle											
	A	A1	B	B1	C	D	E	F	G	H	DE	C&S
2016	19.4	13.8	3.5	2.0	1.9	0.6	1.5	0.4	4.8	12.5	1.0	33.3
2017	42.2	29.4	6.6	4.3	5.0	1.7	3.7	1.0	10.1	27.3	1.9	47.8
2018	64.4	49.1	9.9	6.9	8.6	3.0	6.3	1.9	15.3	43.1	2.9	61.1
2019	83.1	67.0	17.4	9.7	12.7	4.4	9.4	3.0	20.6	59.7	3.9	72.1
2020	99.8	87.9	21.3	13.0	17.5	6.2	12.9	4.5	26.3	78.3	4.9	98.7
2021	116.1	106.7	25.7	16.6	23.0	8.2	17.0	6.3	32.1	98.2	5.9	109.2
2022	133.3	125.3	32.4	20.4	28.6	10.4	21.3	8.2	37.7	118.8	6.9	120.0
2023	149.4	142.3	36.3	23.4	33.4	11.9	24.6	9.4	43.1	138.8	7.9	129.1
2024	165.4	158.8	40.3	26.0	37.9	13.3	27.6	10.4	47.9	157.5	8.9	138.3
2025	181.4	175.1	44.2	29.1	42.9	14.9	30.9	11.6	53.4	177.1	10.1	144.4
2026	186.8	183.5	45.0	30.7	45.2	15.3	32.0	11.7	53.9	185.6	11.6	150.9
2027	192.2	192.6	45.7	32.4	47.6	15.7	34.8	11.9	54.6	194.8	13.2	156.7
2028	197.6	200.6	46.4	33.6	49.5	15.9	37.1	11.9	54.5	202.3	14.8	164.7
2029	202.1	208.7	47.0	34.7	51.4	16.1	38.9	11.8	54.2	213.2	16.5	169.8
2030	207.0	216.0	47.5	35.9	53.1	16.3	40.5	11.7	54.1	223.8	18.1	175.6
2031	211.8	224.0	48.1	37.4	59.6	16.8	42.8	11.8	54.5	236.3	19.8	178.8
2032	218.3	233.5	48.8	39.4	65.6	17.4	45.1	12.1	55.5	249.8	21.4	184.0
2033	224.3	241.5	49.5	40.7	71.1	17.8	46.8	12.1	55.5	259.9	23.1	189.7
2034	229.3	248.9	50.0	41.9	75.9	18.1	48.1	12.1	55.5	268.2	24.9	193.3

The DSR December peak reduction is based on the average of the very heavy load hours (VHLH). The VHLH method takes the average of the five-hour morning peak from hour ending 7 a.m. to hour ending 11 a.m. and the five-hour evening peak from hour ending 6 p.m. to hour ending 10 p.m. Monday through Friday.

Figure D-29: Annual Costs (dollars in thousands)

(Codes and Standards has no cost and is considered a must-take bundle.)

BUNDLE	A	A1	B	B1	C	D	E	F	G	H	DE
2016	$7,770	$25,901	$13,170	$6,787	$9,357	$3,423	$10,369	$2,134	$28,563	$1,223,578	$467
2017	$8,889	$30,144	$11,431	$7,804	$14,871	$5,123	$14,113	$3,550	$30,640	$1,316,151	$467
2018	$8,571	$39,352	$12,578	$8,157	$17,590	$5,714	$16,345	$4,688	$30,939	$1,362,048	$467
2019	$7,952	$36,413	$28,276	$8,370	$20,077	$6,288	$18,409	$5,815	$31,353	$1,404,268	$467
2020	$7,439	$42,626	$14,399	$8,870	$22,316	$7,012	$20,283	$6,898	$31,843	$1,431,323	$467
2021	$7,413	$37,851	$15,913	$9,259	$24,266	$7,643	$22,082	$7,971	$32,319	$1,470,076	$467
2022	$7,494	$38,733	$24,246	$9,880	$26,090	$8,411	$23,826	$9,071	$32,857	$1,527,540	$467
2023	$7,543	$36,956	$15,264	$8,405	$24,122	$6,620	$19,956	$5,805	$31,618	$1,642,856	$467
2024	$7,579	$37,521	$15,528	$8,435	$24,506	$6,708	$20,108	$5,809	$31,650	$1,643,710	$467
2025	$7,510	$34,825	$14,955	$8,306	$24,778	$6,792	$20,203	$5,799	$31,647	$1,608,998	$545
2026	$2,104	$13,956	$2,581	$3,866	$15,208	$1,842	$8,003	$328	$2,092	$907,481	$701
2027	$2,094	$13,791	$2,408	$3,811	$14,920	$1,856	$22,402	$328	$2,075	$902,440	$701
2028	$2,280	$13,969	$2,360	$3,885	$14,810	$1,953	$20,427	$346	$2,088	$919,372	$701
2029	$2,194	$13,623	$2,291	$3,613	$14,193	$1,888	$17,475	$340	$2,058	$1,030,451	$701
2030	$2,243	$13,576	$2,243	$3,601	$13,720	$1,908	$15,044	$346	$2,105	$1,009,367	$701
2031	$2,235	$13,387	$2,199	$3,443	$48,305	$3,446	$19,737	$348	$2,151	$1,057,984	$701
2032	$2,295	$13,376	$2,171	$3,453	$41,098	$3,182	$16,796	$358	$2,214	$995,098	$701
2033	$2,240	$13,083	$2,130	$3,285	$43,056	$2,951	$14,589	$359	$2,250	$949,034	$701
2034	$2,254	$13,066	$2,118	$3,270	$38,260	$2,852	$12,717	$363	$2,340	$918,834	$701
2035	$2,241	$12,914	$2,105	$3,221	$33,124	$2,679	$11,035	$367	$2,389	$905,542	$701

Demand-response Programs are organized into 5 categories. These include:

1. Residential Direct Load Control (DLC) Space Heating
2. Residential DLC Water Heating
3. Residential Critical Peak Pricing (CPP)
4. Commercial and Industrial CPP
5. Commercial and Industrial Curtailment

Figure D-30 describes the total December peak reduction achieved by each program, and Figure D-31 describes the costs for each program.

Figure D-30: Demand-response Programs, Total December Peak Reduction (MW)

	Program				
	1	2	3	4	5
2016	6	6	0	0	12
2017	6	6	0	0	24
2018	33	32	2	0	37
2019	33	33	2	0	50
2020	68	67	10	1	51
2021	69	68	10	1	51
2022	70	69	20	2	52
2023	71	70	21	2	53
2024	72	71	21	2	54
2025	74	72	21	2	55
2026	75	73	22	2	56
2027	76	74	22	2	56
2028	77	75	22	2	57
2029	78	76	22	2	58
2030	79	77	23	2	59
2031	80	78	23	2	60
2032	81	79	23	2	61
2033	82	80	24	2	62
2034	83	81	24	2	63
2035	84	82	24	2	64

Figure D-31: Demand-response Annual Costs (dollars in thousands)

	Program				
	1	2	3	4	5
2016	$3,503	$7,622	$400	$400	$1,224
2017	$777	$2,330	$301	$157	$2,569
2018	$15,918	$34,207	$2,363	$64	$4,061
2019	$2,630	$7,086	$1,348	$680	$5,642
2020	$23,214	$50,445	$10,297	$278	$5,878
2021	$4,565	$11,367	$2,012	$929	$6,091
2022	$4,766	$11,862	$14,163	$387	$6,342
2023	$4,939	$12,301	$513	$36	$6,604
2024	$5,117	$12,754	$517	$37	$6,899
2025	$5,300	$13,218	$520	$38	$7,172
2026	$5,488	$13,695	$524	$39	$7,448
2027	$5,681	$14,184	$528	$41	$7,726
2028	$5,878	$14,686	$531	$43	$8,085
2029	$6,081	$15,202	$534	$44	$8,409
2030	$6,291	$15,734	$539	$46	$8,769
2031	$6,508	$16,285	$545	$49	$9,127
2032	$6,734	$16,857	$552	$51	$9,520
2033	$6,970	$17,453	$563	$53	$9,910
2034	$7,229	$18,103	$584	$55	$10,318
2035	$7,494	$18,762	$603	$56	$10,743

DEMAND FORECASTING MODELS

Contents

This appendix describes the econometric models used in creating the demand forecasts for PSE's 2015 IRP analysis.

ELECTRIC BILLED SALES AND CUSTOMER COUNTS

System-level Model

PSE estimated the following use-per-customer (UPC) and customer count econometric equations using sample dates from a historical monthly data series that extends from January 1989 to December 2013; the sample dates varied depending on sector or class. The billed sales forecast is based on the estimated equations, normal weather assumptions, rate forecasts, and forecasts of various economic and demographic inputs.

The UPC and customer count equations are defined as follows:

$$UPC_{c,t} = f(RR_{c,t(k)}, W_{c,t}, EcoDem_{c,t(k)}, MD_m)$$
$$CC_{c,t} = f(EcoDem_{c,t(k)}, MD_m)$$
$$MD_i = \begin{cases} 1, Month = i \\ 0, Month \neq i \end{cases} \quad i \in \{1,2,\ldots 12\}$$
$$t \in \{1,\ldots,nobs\}$$

$UPC_{c,t}$ = use (billed sales) per customer for class “c”, month “t”

$CC_{c,t}$ = customer counts for class “c”, month “t”

$—_{t(k)}$ = the subscript $t(k)$ denotes either a lag of “k” periods from “t” or a polynomial distributed lag form in “k” periods from month “t”

$RR_{c,t(k)}$ = effective real retail rates for class “c” in polynomial distributed lagged form

$W_{c,t}$ = class-appropriate weather variable; cycle-adjusted HDD/CDD using base temperatures of 65, 60, 45, 35 for HDD and 65 and 75 for CDD; cycle-adjusted HDDs/CDDs are created to fit consumption period implied by the class billing cycles

$EcoDem_{c,t(k)}$ = class-appropriate economic and demographic variables; variables include income, household size, population, employment levels or growth, and building permits in polynomial distributed lagged form

MD_i = monthly dummy variable that is 1 when the month is equal to "i", and zero otherwise for "i" from 1 to 12

UPC is forecast monthly at a class level using several explanatory variables including weather, retail rates, monthly effects, and various economic and demographic variables such as income, household size and employment levels. Some of the variables, such as retail rates and economic variables, are added to the equation in a lagged, or polynomial lagged form to account for both short-term and long-term effects of changes in these variables on energy consumption. Finally, depending on the equation, an ARMA(p,q) structure could be imposed to acknowledge that future values of the predicted variables could be a function of its lag value or the lags of forecast errors.

Similar to UPC, PSE forecasts the customer count equations on a class level using several explanatory variables such as household population, building permits, total employment, manufacturing employment or the retail rate. Some of the variables are also implemented in a lagged or polynomial distributed lag form to allow the impact of the variable to vary with time. Many of the customer equations use monthly customer growth as the dependent variable, rather than totals, to more accurately measure the impact of economic and demographic variables on growth, and to allow the forecast to grow from the last recorded actual value. ARMA(p,q) could also be imposed on certain customer counts equations.

The billed sales forecast for each customer class before new conservation is the product of the class UPC forecast and the forecasted number of customers in that class, as defined below.

$$Billed\ Sales_{c,t} = UPC_{c,t} \times CC_{c,t}$$

The billed sales and customer forecasts are adjusted for known, short-term future discrete additions and subtractions not accounted for in the forecast equations, such as major changes in energy usage by large customers. These adjustments may also include fuel and schedule switching by large customers. The forecast of billed sales is further adjusted for new programmatic conservation by class using the optimal conservation bundle from the most recent IRP.

Total billed sales in a given month are calculated as the sum of the billed sales across all customer classes:

$$Total\ Billed\ Sales_{t} = \sum_{c} Billed\ Sales_{c,t}$$

PSE estimates total system delivered loads by distributing monthly billed sales into each billing cycle for the month, then allocating the billing cycle sales into the appropriate calendar months using degree days as weights, and adjusting each delivered sales for losses from transmission and distribution. This approach also enables computation of the unbilled sales each month.

County-level Model

We use historical data from PSE's billing system to generate customer forecasts by county by estimating an equation that relates customer counts by class and county to population or employment levels in that county. The structure of the county-level customer counts econometric equation is similar to the system-level customer counts equation.

$$CC_{c,t} = f(EcoDem_{c,t(k)}, MD_{m}) \text{ for each county}$$

$EcoDem_{c,t(k)}$ = class-appropriate economic and demographic variables in lagged or polynomial distributed lagged forms; variables include population for residential equation, and employment levels or growth for non-residential equations with AR or MA terms.

The forecasts of county-level customers are further adjusted proportionally so that the total of all customer counts is scaled to the original service area forecast at the class level.

The class-level UPC forecast by county is based on the system-level UPC forecast by class, but adjusted to the county level using the ratio of the county to the system-level historical weather-adjusted UPC by class. County-level billed sales forecasts by class are the product of customer counts and use-per-customer, which are further proportionally adjusted so that the total billed sales across all counties is equal to the system-level billed sales by class.

Known discrete additions or deletions to the county-level billed sales are accounted for in the forecast. Finally, projected conservation savings by class are proportionally allocated to county-level class billed sales using the ratio of class-level billed sales for each county to the system-level billed sales. This amount is deducted from the "before conservation" billed sales forecast by class for each county.

Eastside King County Model

The approach used to develop the forecast of billed sales for the Eastside area of King County is similar to that used for the county-level billed sales forecast. Historical customer counts on a monthly basis are used to estimate customer counts econometric equations by class for just the Eastside area. Again, the structure of the customer counts equation is

$$CC_{c,t} = f(EcoDem_{c,t(k)}, MD_m)$$

$EcoDem_{c,t(k)}$ = class-appropriate economic and demographic variables in lagged or polynomial distributed lagged forms; variables include population for residential equation, and employment levels or growth for non-residential equations with AR or MA terms.

The historical and projected economic and demographic variables such as population and employment are based on Puget Sound Regional Council jurisdiction population and employment databases and Vision 2040 forecasts.

The class-level UPC forecast for the Eastside area is based on King County-level UPC forecast by class but adjusted using the ratio of the Eastside area to the King County-level historical weather-adjusted UPC by class.

Again, billed sales is adjusted for known block loads, as well as for future conservation savings apportioned using the ratio of billed sales for Eastside to King County-level conservation savings.

ELECTRIC PEAK HOUR LOAD FORECASTING

Peak load forecasts are developed using econometric equations that relate observed monthly peak loads to weather-sensitive delivered loads for both residential and non-residential sectors. They account for deviations of actual peak hour temperature from normal peak temperature for the month, day of the week effects, and unique weather events such as a cold snap or an El Niño season.

System-level Forecast

Based on the forecasted delivered loads, we use hourly regressions to estimate a set of monthly peak loads for the system based on three specific design temperatures: "Normal," "Power Supply Operations" (PSO), and "Extreme."

The "Normal" peak is based on the average temperature at the monthly peak during a historical time period, currently 30 years. The winter peaks are set at the highest Normal peak, which is currently the December peak of 23 degrees Fahrenheit. We estimated the PSO peak design temperatures to have a 1-in-20 year probability of occurring. These temperatures were established by examining the minimum temperature of each winter month. An extreme value distribution function relating the monthly minimum temperature and the return probability was established. The analysis revealed the following design temperatures: 15 degrees Fahrenheit for January and February, 17 degrees Fahrenheit for November, and 13 degrees Fahrenheit for December. Finally, the "Extreme" peak design temperatures are estimated at 13 degrees Fahrenheit for all winter months.

Weather dependent loads are accounted for by the major peak load forecast explanatory variable, the difference between actual peak hour temperature and the average monthly temperature multiplied by system loads. The equations allow the impact of peak design temperature on peak loads to vary by month. This permits the weather-dependent effects of system delivered loads on peak demand to vary by season. The sample period for this forecast utilized monthly data from January 2002 to December 2013.

In addition to the effect of temperature, peak load estimates account for the effects of several other variables, among them the portion of monthly system delivered loads that affects peak loads but is non-weather dependent; a dummy variable that accounts for large customer changes; and a day of the week variable. The functional form of the electric peak hour equation is

$$PkMW_t = \vec{\alpha}_{1,m} \cdot MD_i \cdot S_t + \vec{\alpha}_{2,m}\chi_1 \cdot \Delta T \cdot MD_i \cdot S_t + \beta_{1,d} DD_d + \delta_1 \cdot LT_t$$

where:

$$\chi_1 = \begin{cases} 1, & Month = 6,7,8 \\ 0, & Month \neq 6,7,8 \end{cases}$$

$$MD_i = \begin{cases} 1, Month = i \\ 0, Month \neq i \end{cases} \quad i \in \{1,2,\ldots 12\}$$

$PkMW_t$ = monthly system peak hour load in MW

S_t = system delivered loads in the month in aMW

MD_i = monthly dummy variable

ΔT = deviation of actual peak hour temperature from monthly normal temperature

DD_d = day of the week dummy

LT_d = late hour of peak dummy, if the peak occurs in the evening

χ_1 = dummy variables used to put special emphasis on summer months to reflect growing summer peaks.

To clarify the equation above, when forecasting we allow the coefficients for loads to vary by month to reflect the seasonal pattern of usage. However, in order to conserve space, we have employed vector notation. The Greek letters α_m , β_d , and δ_d are used to denote coefficient vectors; there are also indicator variables that account for air conditioning load, to reflect the growing summer electricity usage caused by increased saturation of air conditioning.

The peak load forecast is further adjusted for the peak contribution of future conservation based on the optimal bundle derived from the 2013 IRP.

County-level Forecasts

The county-level peak forecasts are based on the following econometric specification of system monthly peaks as a function of monthly weather and non-weather sensitive loads, and accounting for the deviation of peak temperature from the monthly normal temperature on a seasonal basis, to estimate a system coincident peak forecast. The estimated econometric equation using historical data from January 2002 to December 2012 is represented by

$$PkMW_t = \vec{\alpha}_{1,m} R_t + \vec{\alpha}_{2,m} NR_t + \vec{\alpha}_{3,s} \cdot \Delta T \cdot Ws \cdot Seas + AR(1)$$

Where:

$PkMW_t$ = monthly system peak-hour load in MW

R_t = residential delivered loads in the month in aMW

NR_t = commercial plus industrial delivered loads in the month in aMW

ΔT = deviation of actual peak-hour temperature from monthly normal temperature

Ws = residential plus a % of commercial delivered loads

Seas = (Winter if Month = 11,12,1,2; Summer if Month = 7,8; Other if Month = 3,4,5,6,9,10)

AR(1) = autoregressive term of order 1 for time series functions

The Greek letters $\vec{\alpha}_m$ and $\vec{\alpha}_{3,s}$ are used to denote coefficient vectors.

The county-level system coincident peak forecast before conservation is projected by supplying the above equation with the county's projected residential and non-residential before-conservation loads, and using the design normal peak temperature of 23 degrees Fahrenheit in the ΔT. Each county's normal peak forecast is further adjusted so that the sum of all county peak forecasts is equal to the system peak forecast.

Peak conservation savings are apportioned to each county using the ratio of each county's peak load to the system peak loads, which is used in adjusting each county's peak load forecast.

Eastside King County Level Forecast

The Eastside King County coincident peak load forecast based on the normal design temperature of 23 degrees Fahrenheit was developed in a similar manner as the county-level peak forecasts. In the case of the sub-county-level forecast, historical system coincident peak load data for substations serving the area from January 2008 to March 2014 were collected, in addition to the number of customers and billed sales by customer class. The estimated econometric equation for peak loads has the following form:

$$PkMW_t = \vec{\alpha}_{1,m} R_t + \vec{\alpha}_{2,m} NR_t + \vec{\alpha}_{3,s} \cdot \Delta T \cdot Ws \cdot Seas + \beta \cdot Trend + MA(1)$$

Where:

$PkMW_t$ = monthly Eastside peak-hour load in MW

R_t = Eastside residential delivered loads in the month in aMW

NR_t = Eastside commercial plus industrial delivered loads in the month in aMW

ΔT = deviation of actual peak-hour temperature from monthly normal temperature

Ws = Eastside residential plus a % of commercial delivered loads

$Seas$ = (Winter if Month = 11,12,1,2; Summer if Month = 7,8; Other if Month = 3,4,5,6,9,10)

$Trend$ = time trend starting from 2008, after the housing recession

$MA(1)$ = moving average term of order 1 for time series functions

The Greek letters $\vec{\alpha}$ and β are used to denote coefficients to be estimated.

The coincident normal peak hour load forecast is developed using the forecasts of Eastside residential and non-residential loads, using 23 degrees Fahrenheit as the designed normal temperature. The development of the load forecasts by customer class was previously described above. This peak load forecast is further adjusted for conservation by using the ratio of Eastside to King County peak loads as the share of the Eastside in peak conservation within King County.

GAS BILLED SALES AND CUSTOMER COUNTS

At the gas system level, PSE forecasts use-per-customer (UPC) and customer counts for each of the customer classes it serves. The gas classes include firm classes (residential, commercial, industrial, commercial large volume and industrial large volume), interruptible classes (commercial and industrial) and transport classes (commercial firm, commercial interruptible, industrial firm and industrial interruptible). Energy demand from firm and interruptible classes is summed to form the 2015 IRP Gas Base Demand Forecast.

PSE estimated the following UPC and customer count econometric equations using sample dates from a historical monthly data series that extends from January 1990 to December 2013; the sample dates varied depending on sector or class. The gas billed sales forecast is based on the estimated equations, normal weather assumptions, rate forecasts, and forecasts of various economic and demographic inputs.

The UPC and customer count equations are defined as follows:

$$UPC_{c,t} = f(RR_{c,t(k)}, W_{c,t}, EcoDem_{c,t(k)}, MD_m)$$

$$CC_{c,t} = f(EcoDem_{c,t(k)}, MD_m)$$

$$MD_i = \begin{cases} 1, Month = i \\ 0, Month \neq i \end{cases} \quad i \in \{1,2,\ldots 12\}$$

$$t \in \{1,\ldots,nobs\}$$

$UPC_{c,t}$ = use (billed sales) per customer for class “c”, month “t”

$CC_{c,t}$ = customer counts for class “c”, month “t”

$—_{t(k)}$ = the subscript $t(k)$ denotes either a lag of “k” periods from “t” or a polynomial distributed lag form in “k” periods from month “t”

$RR_{c,t(k)}$ = effective real retail rates for class “c” in polynomial distributed lagged form

$W_{c,t}$ = class-appropriate weather variable; cycle-adjusted HDDs using the base temperature of 65; cycle-adjusted HDDs are created to fit consumption period implied by the class billing cycles

$EcoDem_{c,t(k)}$ = class-appropriate economic and demographic variables; variables include unemployment rate, household size, non-farm employment levels and growth, manufacturing employment levels and growth, and building permits. Economic and demographic variables may be used in lag form or in polynomial distributed lag form.

MD_i = monthly dummy variable that is 1 when the month is equal to "i", and zero otherwise for "i" from 1 to 12

UPC is forecast monthly at a class level using several explanatory variables including weather, retail rates, monthly effects, and various economic and demographic variables such as unemployment rate, non-farm employment and manufacturing employment. Some of the variables, such as retail rates and economic variables are added to the equation in a lagged, or polynomial lagged form to account for both short-term and long-term effects of changes in these variables on energy consumption. Finally, depending on the equation, an ARMA(p,q) structure could be imposed to acknowledge that future values of the predicted variables could be a function of its lag value or the lags of forecast errors.

Similar to UPC, PSE forecasts the gas customer count equations on a class level using several explanatory variables such as household size, building permits, total employment and manufacturing employment. Some of the variables are also implemented in a lagged or polynomial distributed lag form to allow the impact of the variable to vary with time. Many of the customer equations use monthly customer growth as the dependent variable, rather than totals, to more accurately measure the impact of economic and demographic variables on growth, and to allow the forecast to grow from the last recorded actual value. ARMA(p,q) could also be imposed on certain customer counts equations. In addition, some of the smaller customer classes are not forecast using equations; instead, those current customer counts are held constant throughout the forecast period. This is done for the transport classes, industrial interruptible class and industrial large volume class. These classes have low customer counts and are not expected to change significantly over the forecast period.

The billed sales forecast for each customer class, before new conservation, is the product of the class UPC forecast and the forecasted number of customers in that class, as defined below.

$$Billed\ Sales_{c,t} = UPC_{c,t} \times CC_{c,t}$$

The gas billed sales and customer forecasts are adjusted for known, short-term future discrete additions and subtractions not accounted for in the forecast equations, such as major changes in energy usage by large customers. These adjustments may also include fuel and schedule switching by large customers. The forecast of billed sales is further adjusted for new programmatic conservation by class using the optimal conservation bundle from the most recent IRP.

Total billed sales in a given month are calculated as the sum of the billed sales across all customer classes:

$$Total\ Billed\ Sales_{t} = \sum_{c} Billed\ Sales_{c,t}$$

PSE estimates total gas system delivered loads by distributing monthly billed sales into each billing cycle for the month, then allocating the billing cycle sales into the appropriate calendar months using heating degree days as weights, and adjusting each delivered sales for losses from transmission and distribution. This approach also enables computation of the unbilled sales each month.

GAS PEAK DAY LOAD FORECAST

Similar to the electric peaks, the gas peak day is assumed to be a function of weather-sensitive delivered sales, the deviation of actual peak day average temperature from monthly normal average temperature and other weather events. The following equation used monthly data from October 1993 to December 2013 to represent peak day firm requirements:

$$PkDThm_t = \vec{\alpha}_{1,m} Fr_t + \vec{\alpha}_{2,m} \Delta T_g \cdot Fr_t + \alpha_{3,m} EN + \alpha_{4,m} M_t + \alpha_{5,m} Sum + \alpha_{6,m} Csnp$$

$$Win = \begin{cases} 1, & Month = 1,2,11,12 \\ 0, & Month \neq 1,2,11,12 \end{cases}$$

$$Smr = \begin{cases} 1, & Month = 6,7,8,9 \\ 0, & Month \neq 6,7,8,9 \end{cases}$$

where:

$PkDThm_t$ = monthly system gas peak day load in dekatherms

Fr_t = monthly delivered loads by firm customers

ΔT_g = deviation of actual gas peak day average daily temperature from monthly normal temperature

EN = dummy for when El Niño is present during the winter

M_t = dummy variable for month of the year

$CSnp$ = indicator variable for when the peak occurred within a cold snap period lasting more than one day, multiplied by the minimum temperatures for the day

As before, the Greek letters are coefficient vectors as defined in the electric peak section above.

This formula uses forecasted billed sales as an explanatory variable, and the estimated model weighs this variable heavily in terms of significance. Therefore, the peak day equation will follow a similar trend as that of the billed sales forecast with minor deviations based on the impact of other explanatory variables. An advantage of this process is that it helps estimate the contribution of distinct customer classes to peak loads.

The design peak day used in the gas peak day forecast is a 52 heating degree day (13 degrees Fahrenheit average temperature for the day), based on the costs and benefits of meeting a higher or lower design day temperature. In the 2003 LCP, PSE changed the gas supply peak day planning standard from 55 heating degree days (HDD), which is equivalent to 10 degrees Fahrenheit or a coldest day on record standard, to 51 HDD, which is equivalent to 14 degrees Fahrenheit or a coldest day in 20 years standard. The Washington Utilities and Transportation Commission (WUTC) responded to the 2003 plan with an acceptance letter directing PSE to "analyze" the benefits and costs of this change and to "defend" the new planning standard in the 2005 LCP.

As discussed in Appendix I of the 2005 LCP, PSE completed a detailed, stochastic cost-benefit analysis that considered both the value customers place on reliability of service and the incremental costs of the resources necessary to provide that reliability at various temperatures. This analysis determined that it would be appropriate to increase our planning standard from 51 HDD (14 degrees Fahrenheit) to 52 HDD (13 degrees Fahrenheit). PSE's gas planning standard relies on the value our natural gas customers attribute to reliability and covers 98 percent of historical peak events. As such, it is unique to our customer base, our service territory and the chosen form of energy. Thus, we use projected delivered loads by class and this design temperature to estimate gas peak day load.

MODELING UNCERTAINTIES IN THE LOAD FORECAST

Load forecasts are inherently uncertain, and to acknowledge this uncertainty, high and low load forecasts are developed. There are many sources of uncertainties in the load forecasts including weather and modelling errors, but a key driver in loads are the assumptions on economic and demographic growth within the service territory. Since the IRP focuses on long-term uncertainty, the high and low load forecasts are based on uncertainties related to long-term economic and demographic growth.

The econometric load forecast equations depend on certain types of economic and demographic variables; these may vary depending on whether the equation is for customer counts or use-per-customer, and whether the equation is for residential or non-residential customer class. In PSE's load forecast models, the key service area economic and demographic inputs are population, employment, unemployment rate, personal income and building permits. These variables are inputs into one or more load forecast equations.

The high and low load forecasts are defined in the IRP as the 95th and 5th percentile, respectively, of the stochastic simulation of the loads based on uncertainties in the economic and demographic inputs. To develop the stochastic simulations of loads, a stochastic simulation of PSE's economic and demographic electric and gas models is performed to produce the distribution of PSE's economic and demographic forecast variables. The forecasts of PSE's economic and demographic variables are also a function of key U.S. macroeconomic variables such as population, employment, unemployment rate, personal income, personal consumption expenditure index and long-term mortgage rates. We utilize the stochastic simulation functions in EViews, a popular econometric, forecasting and simulation tool, by providing the standard errors of the quarterly growths of key U.S. macroeconomic inputs into the PSE's economic and demographic models. These standard errors were based on historical actuals from 1980 to 2013. The stochastic simulation of PSE's economic and demographic models from 1,000 draws provides the basis for developing the distribution of the relevant economic and demographic inputs for the load forecast models over the forecast period. Based on these distributions, standard errors were estimated for PSE service area population, employment, unemployment rate, personal income and building permits for each year over the forecast horizon. In a similar manner, these standard errors were used in producing the 250 stochastic simulations of PSE's load forecasts within EViews. The 5th and 95th percentile of these stochastic simulations were used as the low and high load forecasts in the 2015 IRP.

HOURLY ELECTRIC DEMAND PROFILE

Because temporarily storing large amounts of electricity is costly, the minute-by-minute interaction between electricity production and consumption is very important. For this reason, and for purposes of analyzing the effectiveness of different electric generating resources, an hourly profile of PSE electric demand is required.

We use our hourly (8,760 hours) load profile of electric demand for the IRP for the stochastic analysis in the Resource Adequacy Model (RAM), for our power cost calculation and for other AURORA analyses. The estimated hourly distribution is built using statistical models relating actual observed temperatures, recent load data and the latest customer counts.

Data

PSE developed a representative distribution of hourly temperatures based on data from January 1, 1950 to December 31, 2014. Actual hourly delivered electric loads between January 1, 1994 and December 31, 2014 were used to develop the statistical relationship between temperatures and loads for estimating hourly electric demand based on a representative distribution of hourly temperatures.

Methodology for Distribution of Hourly Temperatures

The above temperature data were sorted and ranked to provide two separate data sets:
For each year, a ranking of hourly temperatures by month, coldest to warmest, over 60 years was used to calculate average monthly temperature. A ranking of the times when these temperatures occurred, by month, coldest to warmest, was averaged to provide an expected time of occurrence. Next PSE found the hours most likely to have the coldest temperatures (based on observed averages of coldest-to-warmest hour times) and matched them with average coldest-to-warmest temperatures by month. Sorting this information into a traditional time series then provided a representative hourly profile of temperature.

Methodology for Hourly Distribution of Load

For the time period January 1, 1994 to December 31, 2014, PSE used the statistical hourly regression equation:

$$\hat{L}_h = \vec{\beta}_{1,d} \cdot DD_d + \alpha_1 L_{h-1} + \alpha_2 \left(\frac{L_{h-2} + L_{h-3} + L_{h-4}}{3}\right) + \left(\vec{\alpha}_{3,m} T_h + \vec{\alpha}_{4,m} T_h^2\right) + \vec{\beta}_{2,d} Hol + \alpha_5 P^{(1)}(h)$$

for hours from one to 24 to calculate load shape from the representative hourly temperature profile. This means that a separate equation is estimated for each hour of the day.

$\hat{L}_h$ = Estimated hourly load at hour “h”

L_h = Load at hour “h”

L_{h-k} = Load “k” hours before hour “h”

T_h = Temperature at time “h”

T_h^2 = Squared hourly temperature at time “h”

$P^{(1)}(h)$ = 1st degree polynomial

Hol = NERC holiday dummy variables

All Greek letters again denote coefficient vectors.

REGIONAL RESOURCE ADEQUACY STUDIES

Contents

PSE utilized the results and data from three studies on regional load/resource balance in the preparation of the 2015 IRP. They include the **Pacific Northwest Power Supply Adequacy Assessment for 2020-21***, published May 6, 2015 by the Northwest Power and Conservation Council (NPCC); the* **Northwest Regional Forecast of Power Loads and Resources 2016 through 2025***, published in April 2015 by the Pacific Northwest Utilities Conference Committee (PNUCC); and the* **2014 Pacific Northwest Loads and Resources Study** *published by the Bonneville Power Administration (BPA). The NPCC and PNUCC studies appear in the following pages. The BPA study can be accessed at http://www.bpa.gov/power/pgp/whitebook/2014/.*

Appendix G, Wholesale Market Risk, describes how PSE used the data and results from the studies in its analysis.

Northwest **Power** and
Conservation Council

April 28, 2015

MEMORANDUM

TO: **Council Members**

FROM: **John Fazio, Senior Systems Analyst**

SUBJECT: **Resource Adequacy Assessment for 2020 and 2021**

BACKGROUND:

Presenter: John Fazio

Summary In 2011, the Council adopted a methodology to assess the adequacy of the Northwest's power supply. The purpose of this assessment is to provide an early warning should resource development fail to keep pace with demand growth. The Council assesses resource adequacy every year, examining the ability of the power supply to meet regional demand five years out.

The Council's maximum threshold for loss-of-load probability (LOLP) is set at five percent. This means that the power system has a five percent chance of having a shortfall (not necessarily an outage) sometime during the year being examined. The last assessment, done for the 2019 operating year, indicated that the region was slightly in adequate with a LOLP of six percent. The current adequacy assessment for 2020 shows an LOLP of five percent, just at the Council's adequacy threshold.

Many changes have occurred since last year's assessment. First, the Council's load forecast was revised downward. Because of this, the 2020 annual average load is 310 average megawatts lower than the average load used for the 2019 assessment. This effect alone drops the 2020 LOLP to a little under four percent. However, assumptions regarding the region's generating capability have also changed. The biggest change is the removal of the 250 megawatt Big Hanaford plant (an independent power producer). Also, the hydroelectric system's generation was modified to account for amendments to the biological opinion.

Of greater interest perhaps, is the adequacy assessment for 2021, when the Boardman and Centralia 1 coal plants are scheduled to retire (their total winter peaking capacity is on the order of 1,200 MW). These plants are scheduled to retire in December of 2020 but because the Council's operating year runs from October through September, they will be available for use for the first three months of that operating year. Based on this schedule, the LOLP for 2021 is 7.6 percent and the region would need to acquire about 1,000 megawatts of dispatchable generation to bring the LOLP back to the five percent standard.

The Council, however, is also interested in the more generic study that examines the adequacy of the power supply with these two coal plants out for the entire operating year. For that scenario, the LOLP rises to about eight percent and the region would need to acquire about 1,150 megawatts of new capacity. Of course, a more optimum resource strategy that provides an adequate, efficient, economic and reliable supply will be developed for the Council's Seventh Power Plan.

The Resource Adequacy Advisory Committee will be reviewing the summary adequacy report (attached) on May 1st and the committee's comments will be presented to the Council on May 6th.

Recommendation: Both the advisory committee members and Council staff are recommending that an action item be added to the Council's seventh plan to review both the metric (LOLP) and threshold (5 percent) of the Council's current adequacy standard. Part of the impetus for this recommendation is that the North American Electric Reliability Corporation (NERC) is using different metrics (which we also calculate) to measure adequacy. The recommendation is not necessarily to change the Council's standard but to review it in conjunction with what other regions are doing and with how this model is being used by the Council and by others.

Relevance: Besides being an early warning to ensure that the regional power supply remains adequate, the Council's adequacy standard is converted into Adequacy Reserve Margins (for both energy and capacity) that are fed into the Regional Portfolio Model to ensure that resource strategies developed by that model will produce an adequate supply.

Workplan: 1.C. Co-chair and manage the Resource Adequacy Advisory Committee

Background: Since the late 1990s, the Council has worked to develop a more robust method of assessing the adequacy of the region's power supply. In 2011 it formally adopted the loss-of-load probability (LOLP) metric as the measure to assess adequacy and set its maximum threshold at five percent. The Council reassesses this every year, looking at the adequacy of the power supply five years out.

More Info: Summary information and updates are available at: http://www.nwcouncil.org/energy/resource/home

DRAFT

Pacific Northwest Power Supply Adequacy Assessment for 2020-21

May 6, 2015

Executive Summary

The Pacific Northwest's power supply is expected to be close to adequate through 2020. The Council estimates that the likelihood of a power supply shortage in that year is just under the 5-percent standard set by the Council in 2011. By 2021, however, after the planned retirements of the Boardman and Centralia-1 coal plants (1,330 MW nameplate), the likelihood of a shortfall (also referred to as the Loss-of-load Probability or LOLP) rises to a little over 8 percent[1] and would lead to an inadequate supply without intermediate actions.

These results are based on a probabilistic analysis that examines the operation of the power supply over thousands of different combinations of river runoff volume, wind generation, forced outage and temperature for the 2020/21 operating years. However, in each case, the underlying demand was set to the Council's medium forecast and the availability of imports from the southwest was also set to a fixed value. If demand growth were to vary from the medium forecast or if the availability of imports were to change, the LOLP could drop as low as one percent or rise as high as 17 percent. The availability of imports depends not only on surplus generating capability in the southwest but also on the south-to-north transmission capacity. Currently, the limiting factor during winter months is the transmission capacity. Resource adequacy is assessed every year because the power supply is dynamic, in the sense that factors such as demand and import availability can change unexpectedly.

The results above assume that the region will continue to acquire energy efficiency savings as targeted in the Council's Sixth Power Plan, which amount to about 1,700 average megawatts through 2020. While no other resource acquisitions are required to maintain adequacy through 2020, the region will likely have to plan for additional resources before 2021 when the two coal plants are retired. Actions to bring the 2021 power supply into compliance with the Council's standard will vary depending on the types of new generating resources or demand reduction programs that are considered. For example, adding 1,150 megawatts of gas-fired generation would bring the LOLP back to 5 percent.

In all likelihood, some combination of new generation and load reduction programs will be used to bridge the gap. It should be noted that developing a strategy to provide the region with an adequate, efficient, economical and reliable power supply is beyond the scope of this analysis. Designing such a strategy is more appropriately done in the Council's Power Plan, which is due out later this year.

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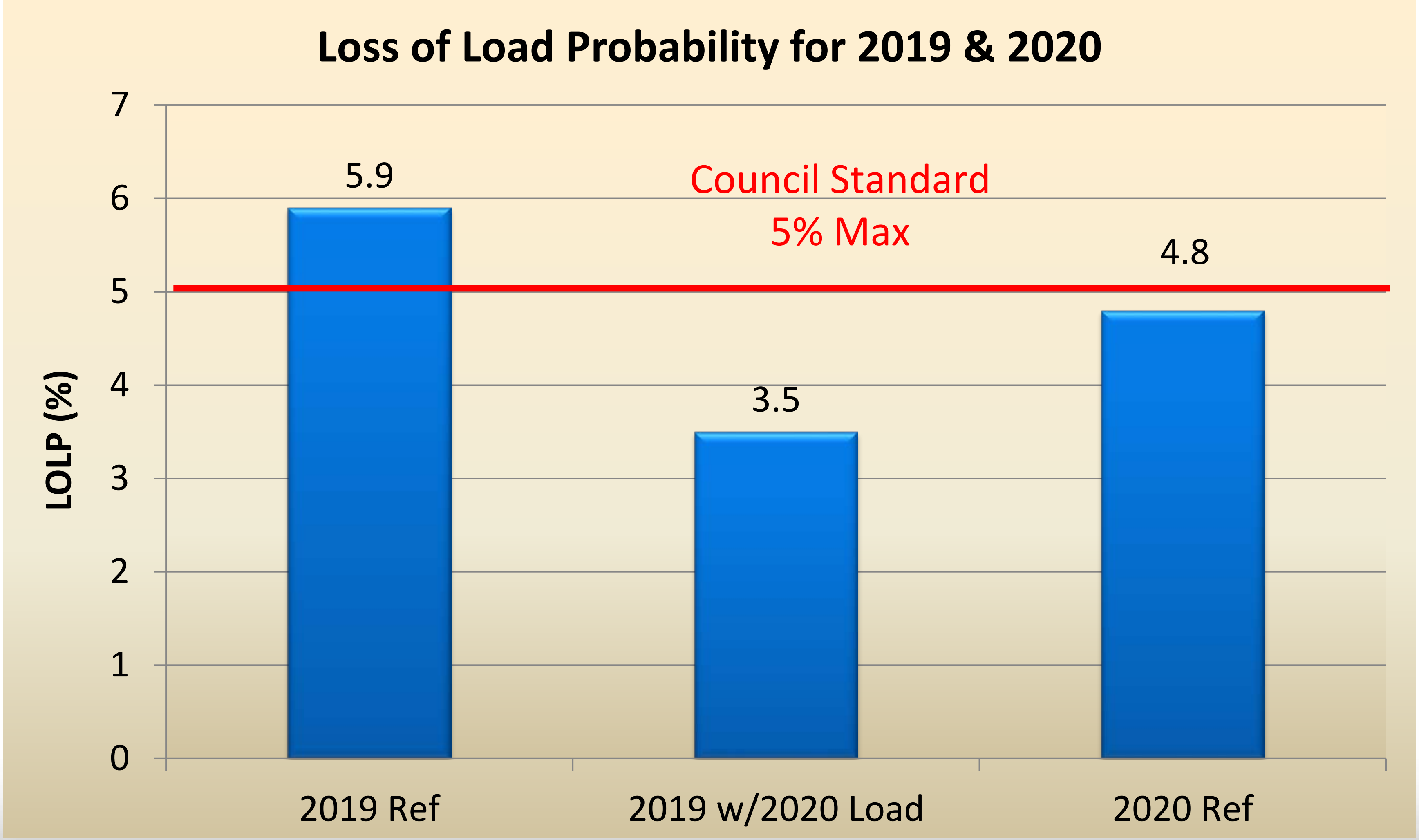
[1] Boardman and Centralia 1 coal plants are scheduled to retire in December of 2020. However, because the Council's operating year runs from October 2020 through September 2021, these two plants would be available for use during the first three months of the 2021 operating year. For this scenario, the LOLP is 7.6 percent. The Council must take into account the long term effects of these retirements and, therefore, uses the more generic study that has both plants out for the entire operating year.

This analysis only counts existing resources and those that are sited and licensed. Northwest utilities, as reported in the Pacific Northwest Utilities Conference Committee's 2015 Northwest Regional Forecast show a combined 900 megawatts of planned generating capacity over the next 10 years. But as conditions change over the next few years, it is expected that utilities will amend their resource acquisition strategies to ensure that sufficient investments in new resources will be made to maintain an adequate supply.

2020-21 Final Resource Adequacy Assessment

NW Power and Conservation Council Meeting
Portland, Oregon
May 6, 2015

2020 Final Assessment



Final Results for 2020

Load Adjust> Spot Import[1]	**Low -2.5%**	**-1.5%**	**Med 0%**	**+1.5%**	**High +2.5%**
0	10.1%	10.2%	13.3%	14.2%	17.5%
1500 MW	4.4%	5.0%	6.2%	7.3%	8.3%
2500 MW	3.2%	3.8%	4.8%	5.9%	6.9%
3400 MW	1.4%	1.9%	2.7%	3.4%	3.9%
4500 MW	0.2%	0.4%	0.7%	1.3%	1.7%

[1]Winter spot-market availability (from the SW). South-to-North intertie transfer capability set to 3,400 max to also accommodate firm transfers. Based on historical calculations there is a 95% chance that transfer capability will be 3,400 MW or greater.

RAAC Recommendations
(for the 2020/21 assessment)

- LOLP Table
  - Add firm imports and intertie capacity
  - Add studies with different imports
- Give indication of LOLP error
  - Due to statistical effects (seed, games, etc.)
  - Roughly ± 0.5% LOLP
- Assessment good to go, with changes

Final LOLP Results for 2020

Winter Imports (MW)		Load Variation				
Spot/Firm	S-to-N Cap	Low -2.5%	-1.5%	Med 0%	+1.5%	High +2.5%
0/425	3400	10.1%	10.2%	13.3%	14.2%	17.5%
1500/425	3400	4.4%	5.0%	6.2%	7.3%	8.3%
2500/425	3400	3.2%	3.8%	4.8%	5.9%	6.9%
2975/425	3400					
3400/425	3900	1.4%	1.9%	2.7%	3.4%	3.9%
4000/425	4500					

Effects of Coal Retirement 2021

- Resource changes 2020 to 2021
  - Boardman retires 600/522 MW
  - Centralia 1 retires 730/670 MW
  - Total loss of 1,330/1,192 MW

    (nameplate/winter capacity)

- Load change 2020 to 2021
  - 6^{th} Plan EE savings (350 aMW)
  - Net load growth of ≈40 aMW (~0.18%)

2021 Adequacy Assessment

- Plants retire on December 31, 2020
- 2021 operating year Oct 2020 – Sep 2021
- Operational for 1st three months
- LOLP = 7.6%
- Needed capacity = 1,000 MW

- Generic Study (with coal out all year)
- LOLP = 8.3%
- Needed capacity = 1,150 MW

Summary of 2021 Analysis
(Generic Study[1])

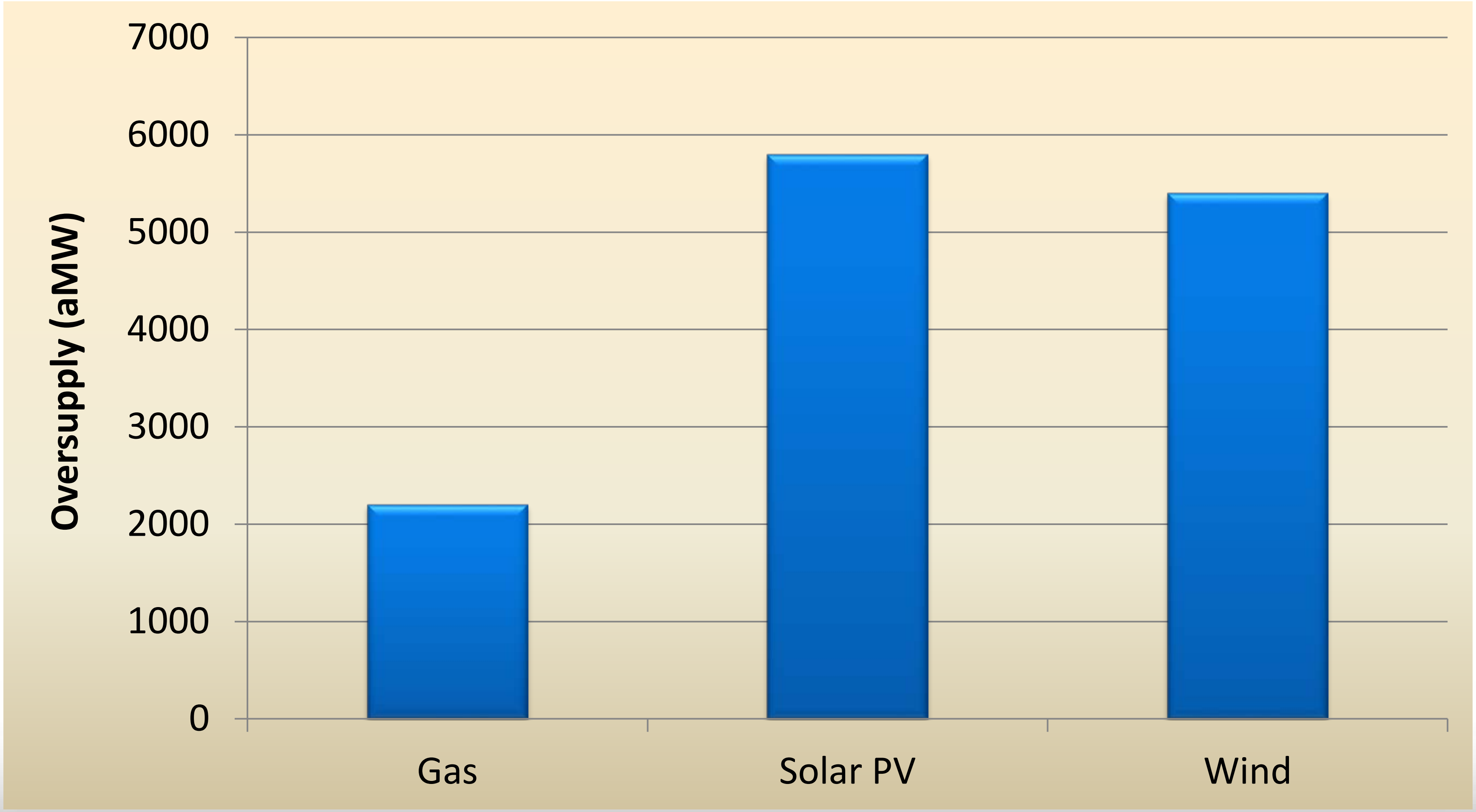
	2013 Analysis	2014 Analysis	2015 Analysis
Changes in Loads and Resources	N/A	+660 MW Gen	-250MW Gen -310 aMW Load
5-year out LOLP	6.6%	5.9%	4.8%
MW needed	700 MW[2]	400 MW	- 80 MW
2021 LOLP	15.3%	10.9%	8.3%
MW needed	2,000 MW	1,700 MW	1,150 MW
Net MW needed	**1,300 MW**	**1,300 MW**	**1,230 MW**

[1]Generic means results of coal retirement over entire operating year.
[2]This is an updated estimate.

Coal Replacement Resources Needed to get to 5% LOLP

- Gas 1.15 GW
- Solar PV 12.7 GW
  - Current US installed 15.9 GW
  - Projected by 2021 for PNW ≈ 450 MW
- Wind 10 GW
  - <u>Only achieved an LOLP of 6.9%</u>
  - More wind did not help

Effects on June Oversupply
(Expected Amount)



RAAC Recommendations
(for future assessments)

- Add action item to review the LOLP metric
- Account for intertie outages
- Review load shapes in more detail
- Research "market friction"
- Research gas supply limitations
- Continue to work on 3-node analysis
- Review hydro dispatch, recommend changes, if needed

Northwest Regional Forecast

of Power Loads and Resources

2016 through 2025

PNUCC

April 2015

Special thanks to PNUCC System Planning Committee members and utility staff that provided us with this information.

Electronic copies of this report are available on the

PNUCC website

www.PNUCC.org

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Portland, OR 97204

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Table of Contents

2015 Northwest Regional Forecast
Executive Summary

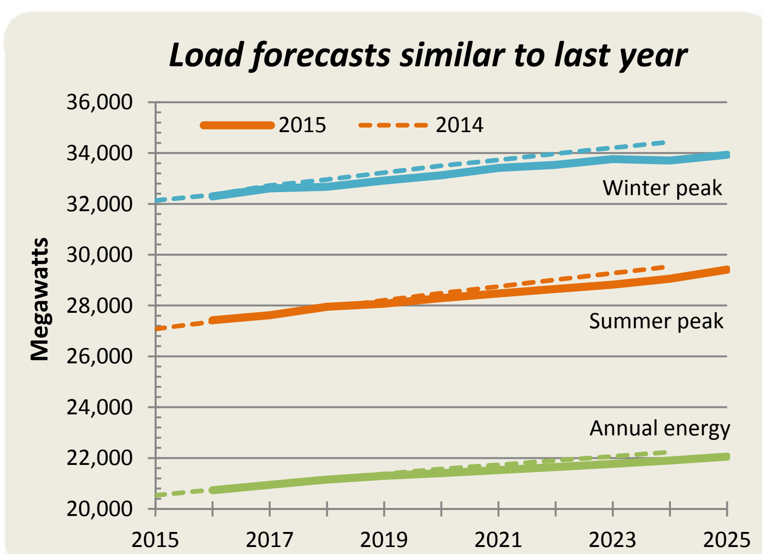
The *Northwest Regional Forecast (Forecast)* projects Northwest electric utilities' expected loads and the power supply required to meet them through 2025. These load forecasts and resource plans have been made amidst future uncertainties. Weather and water conditions are always known to vary, while changing state and federal policies regarding carbon emissions and renewable portfolio standards will continue to add a significant amount of uncertainty to utility planning. If we throw in California's changing resource landscape, Northwest utilities have a real stew to consider.

This annual single point forecast is the sum total of the utilities' integrated resource plans. It is a snapshot that gauges the need to acquire resources on a regional basis through multiple metrics. Annual and monthly energy, and winter and summer peak needs are all tallied, providing a valuable indicator of the region's power system and how it has changed compared to past *Forecasts*.

Included in PNUCC's forecasted loads are savings from expected conservation. The total resources include generating facilities, demand response and purchases that are on the books, as well as new power supplies that are coming online to keep utility customers' homes and businesses warm, lighted and humming.

Little Change in Projected Regional Loads

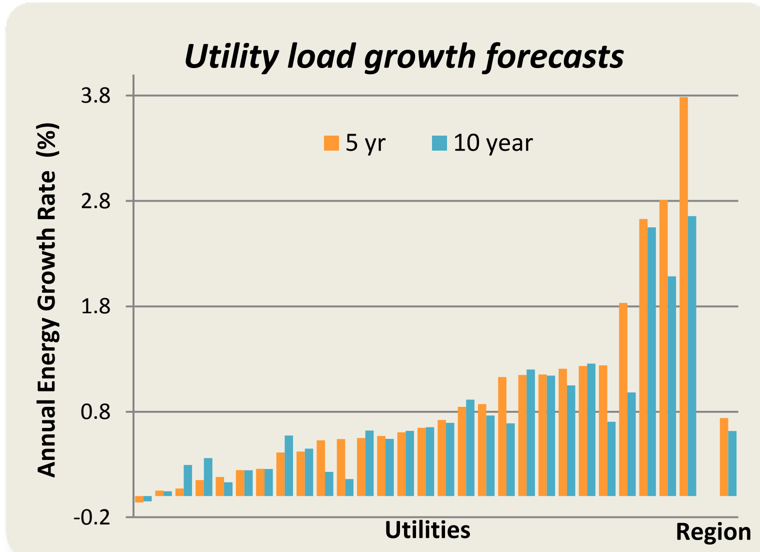
Similar to last year's *2014 Forecast,* regional loads (i.e. electric demand) are expected to grow, but at a modest pace. The ten year annual growth rates in this year's report are all well under one percent for regional loads. The winter peak load is projected to grow at 0.6%, annual average load at 0.7% and summer peak load with the steepest growth at 0.8%. The slight drop from last year is seen in the adjacent chart.



Successful conservation initiatives driven by utilities and others are having a dampening effect on load growth. In a related vein, recently implemented federal standards are making their way into utilities' load projections and contribute to the forecast of slower load growth.

One size doesn't necessarily fit all

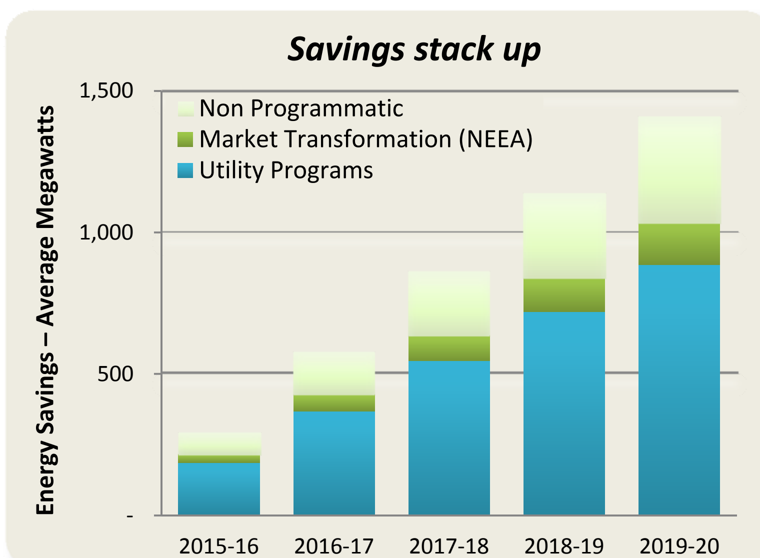
The projected regional load is a tally of individual utilities' loads. Try as some might, sweeping generalizations cannot be made about the region's utilities when discussing load forecasts. Each utility has its own unique circumstances, and this year, there are substantial variations among their forecasts.



While the region overall paints a a fairly flat forecast of loads, there are individual utilities projecting a definite bump in demand due to new large loads, such as server farms in smaller utliity service areas. But these are select, anecdotal cases. In contrast there are utilities with large conservation programs and efficient new housing where loads are expected to grow slowly, even with increasing customer hookups. The growth rates of individual utilities range from slightly negative to 3.8 percent depending on the utility's situation.

Conservation Savings Continue to Accumulate

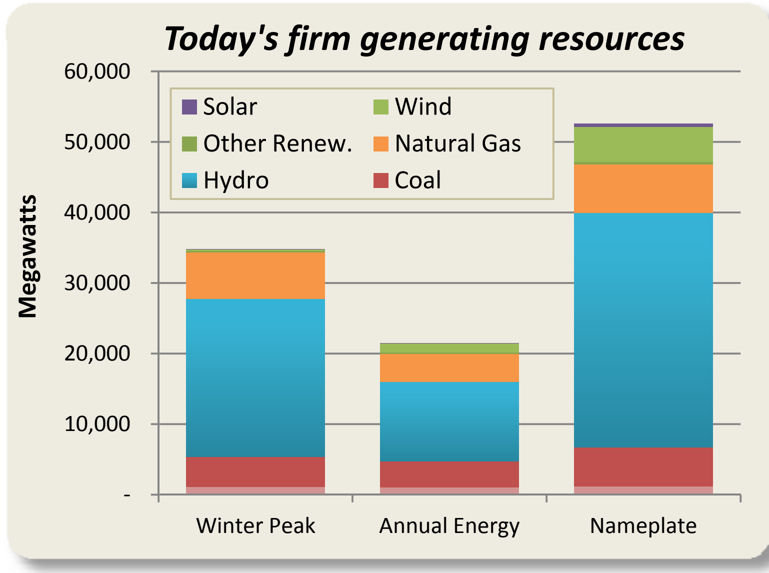
Northwest utilities have reported total savings from their programs that average over 200 MWa a year for the last five years. Looking ahead utilities expect similar success. Over the next five years utilities predict they will achieve cumulative annual energy savings of almost 900 MWa from their energy efficiency programs. When savings from market transformation efforts and non-programmatic activities are added in the stack grows significantly.



These programs will have an impact on peak needs as well. A ballpark estimate from utilities is that five years out their programs could reduce winter peak need by nearly 1,200 MW. The story here is that conservation is working – whether it is a utility sponsored program, changes in technology or consumers choosing more efficient options.

Hydro is Power Supply Foundation

While the region's number and types of generating resources continues to grow, hydropower remains the big kid on the block no matter how you look at it. Out of the 33,200 MW of hydropower's namplate capability we count on 22,400 MW for winter peak and 11,200 MWa in our tabulations. These estimates are based on low water conditions for our planning purposes. Hydro is an invaluable resource for all aspects of our region's power supply, from base load generation and meeting peak demand, to helping integrate variable energy resources such as solar and wind.

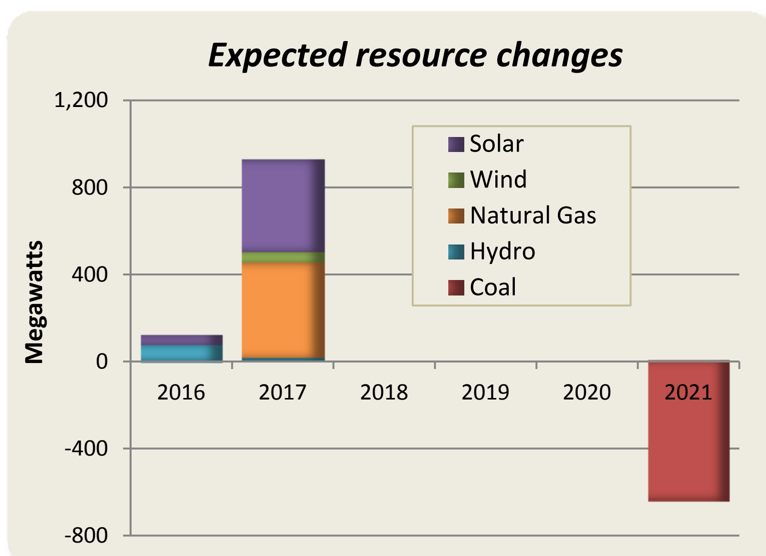


Power mix continues to evolve

In 2014, utilities added, in terms of nameplate rating, about 900 MW of resources, inclduing wind, biomass and the 220 MW Port Westward 2 natural gas plant.

This coming year, another 440 MW natural gas-fired plant Carty Generating Station is coming online. In addition, there continues to be gains in hydro generation with generator replacements. And we will see more than 420 MW of solar power and 50 MW of wind come into the system via the Public Utility Regulatory Policy Act (PURPA).

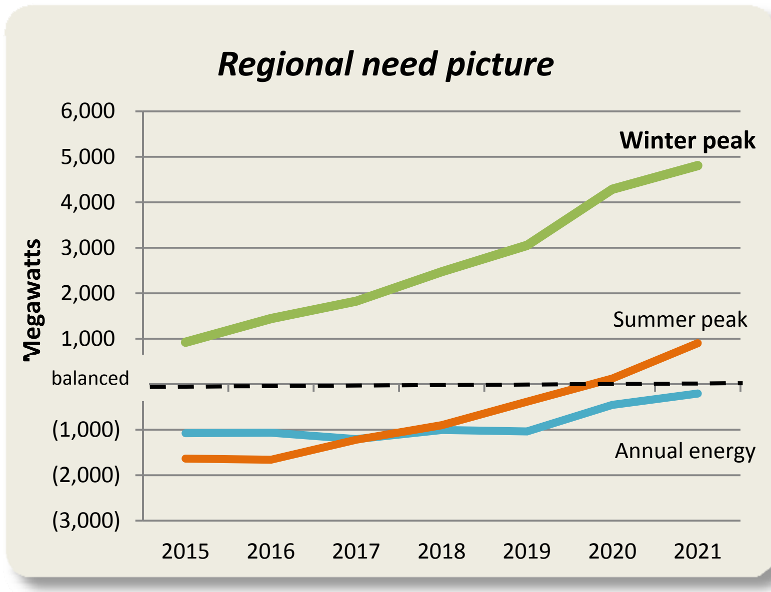
Within the *Forecast* time frame, Boardman coal plant is scheduled for closure. It is yet to be determined how the power it supplies will be replaced.



Winter Peak Need Draws Attention

Of the need for power metrics in this *Forecast* the winter peak need is the most noteworthy. The chart shows the bottom line comparison of requirements and resources for winter peak, summer peak and annual energy. The annual energy picture indicates a surplus through time. What the picture doesn't capture is the monthly shape that has both surplus and deficit seasons.

The regional summer peak is forecast to be surplus until 2020 and then crosses over to a need situation. The more eastern utilities are keeping a close watch on the summer situation already.



The regional winter peak picture starts with over a 900 MW need for power and grows if utilities take no action. This deficit is due mostly to growing winter peak requirements. Further out in time the scheduled closure of resources such as the Boardman coal plant by 2021 will add to this mounting need.

Gains made, more to do

While we have a close eye on winter loads and resources, it is worth noting that a look back over the last several years shows the gains that have been made to address the winter peak gap. Utilities' flattening forecasts of expected firm requirements are in part due to conservation and trimmed down commitments to selling power outside the region. Newly constructed and acquired resources along with demand response opportunities have contributed to the smaller winter peak need too. Back in 2007 the winter need in the first year of the *Forecast* was projected to be over 3,300 MW. Since that time it has tapered off to an expected 2,000 MW in 2011 and down to about 900 MW for the first year of this report.

Looking ahead, the gap is widening without utility action. Growing loads and the increasing planning margin to account for uncertainty through time, and the Boardman coal plant retirement are contributing to the projected need. Utilities are studying the need for generation to determine the best course of action to meet customers' needs. And they are factoring in the knowledge that the power market will shrink with the retirement of the two independently-owned Centralia coal units, one by 2021 and the other in 2025 for a total 1,340 MW loss.

Power Market Helps Fills the Gap

In addition to the single point comparison of requirements and resources discussed above, we examined the Northwest's reliance on the spot market when uncertainty in resource performance and loads are brought into the picture.

The operation of the system in year 2021 was mimicked repeatedly with randomly chosen loads, water conditions, and resource outages. We tracked how much and how often the spot market power was needed used.

We found that the spot power market supplemented utility-owned resources most often in winter. The table below provides a summary. For example, during 10% of the replications of 2021 at least 4,500 MW of spot market power was purchased for at least 1 hour to keep the lights on during the winter. Spot market power was available from power generated by Northwest based independent power producers and power imported from other regions.

Market Reliance: Winter 2021

Odds of market purchases (% of simulations)	1 hour purchase (MW)
5%	6,500
10%	4,500
25%	1,500
50%	0

Overall, the study tells a story similar to the other *Forecast* data: as a region, the Northwest sees its greatest need for power in the winter, and cannot always meet this need using utility-owned resources alone.

Overview

Each year the *Northwest Regional Forecast* compiles utilities' 10-year projections of electric loads and resources which provide information about the region's need to acquire new power supply. The Forecast is a comprehensive look at the capability of existing and new electric generation resources, long-term firm contracts, expected savings from demand side management programs and other components of electric demand for the Northwest.

This report presents estimates of annual average energy, seasonal energy and winter and summer peak capability in Tables 1 through 4 of the Northwest Region Requirements and Resources section. These metrics provide a multi-dimensional look at the Northwest's need for power and underscore the growing complexity of the power system.

Northwest generating resources are shown by fuel type. Existing resources include those resources listed in Tables 5, 6a, 8a and 8b. Table 5, Recently Acquired Resources, highlights projects and supply that became available most recently. And Table 6a, Committed New Supply, lists those generating projects where construction has started, as well as contractual arrangements that have been made for providing power at a future time. Table 8a, Northwest Generating Resources, is a comprehensive list of generating resources that make up the electric power supply for the Pacific Northwest that are utility-owned or utility contracted. Table 8b lists Northwest generating resources owned by independent power producers.

In addition, utilities have demand side management programs in place to reduce the need for generating resources. Table 6b, Demand Side Management Programs, provides a snapshot of utilities' expected savings from these programs for the next ten years. Table 7, Planned Resources, is a compilation of what utilities have reported in their individual integrated resource plans to meet future need.

Planning Area

The Northwest Regional Planning Area is the area defined by the Pacific Northwest Electric Power Planning and Conservation Act. It includes: the states of Oregon, Washington and Idaho; Montana west of the Continental Divide; portions of Nevada, Utah, and Wyoming that lie within the Columbia River drainage basin; and any rural electric cooperative customer not in the geographic area described above, but served by BPA on the effective date of the Act.

Northwest Region Requirements and Resources

Table 1: ***Northwest Region Requirements and Resources – Annual Energy*** shows the sum of the individual utilities' requirements and resources for each of the next 10 years. Expected firm load and exports make up the total firm regional requirements.

Annual Energy (MWa)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Firm Requirements										
Load [1/]	20,730	20,947	21,154	21,300	21,407	21,524	21,647	21,773	21,906	22,052
Exports	559	537	509	484	477	472	468	463	459	450
Total	21,289	21,484	21,663	21,785	21,884	21,996	22,114	22,236	22,365	22,502
Firm Resources										
Hydro	11,283	11,243	11,243	11,239	11,239	11,239	11,239	11,239	11,239	11,239
Small Therm & Misc.	-	-	-	-	-	-	-	-	-	-
Natural Gas	3,973	4,309	4,352	4,435	4,440	4,429	4,458	4,510	4,488	4,474
Renewables-Other	213	213	213	213	212	210	207	204	204	204
Solar	1	81	132	132	132	132	132	132	132	132
Wind	1,297	1,298	1,298	1,298	1,297	1,294	1,223	1,207	1,193	1,187
Cogeneration	62	49	49	49	35	28	11	9	9	9
Imports	798	785	784	786	789	792	795	797	800	757
Nuclear	1,075	916	1,075	916	1,075	916	1,075	916	1,075	916
Coal	3,663	3,655	3,724	3,721	3,702	3,412	3,177	3,200	3,251	3,178
Total	22,365	22,548	22,869	22,790	22,921	22,452	22,317	22,215	22,392	22,096
Surplus (Need)	1,076	1,064	1,207	1,005	1,037	455	203	(21)	27	(406)

[1/] Loads net of conservation.

Table 2: ***Northwest Region Requirements and Resources 2015-16 Monthly Energy*** shows the sum of individual utilities' requirements and resources for monthly energy values for the 2015-16 operating year. Expected firm load and exports make up the total firm regional requirements.

Monthly Energy (MWa)	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Ave
Firm Requirements													
Load [1/]	20,202	18,866	18,973	21,171	23,664	23,423	22,418	20,748	19,658	19,118	19,659	20,978	20,730
Exports	1,021	884	568	524	526	525	525	524	523	533	870	887	559
Total	21,223	19,750	19,540	21,695	24,190	23,949	22,943	21,272	20,181	19,651	20,529	21,865	21,289
Firm Resources													
Hydro	11,933	8,625	9,739	11,184	13,262	10,210	8,855	10,168	9,884	11,878	16,035	13,364	11,283
Small Therm.& Misc.	-	-	-	-	-	-	-	-	-	-	-	-	-
Natural Gas	4,179	3,841	3,959	3,870	4,239	4,215	3,895	3,843	3,672	3,312	4,154	4,496	3,973
Renewables-Other	212	213	216	216	214	201	212	214	204	204	207	213	213
Solar	1	1	1	0	0	0	1	1	1	1	1	1	1
Wind	1,305	1,205	1,203	1,115	1,188	1,204	1,147	1,491	1,420	1,402	1,511	1,365	1,297
Cogeneration	60	56	65	66	71	71	67	72	62	52	45	60	62
Imports	651	617	648	893	1,098	979	907	849	740	714	728	759	798
Nuclear	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075
Coal	3,862	3,863	3,862	3,863	3,862	3,859	3,822	3,498	2,900	3,063	3,650	3,856	3,663
Total	23,279	19,495	20,768	22,283	25,010	21,814	19,981	21,210	19,958	21,703	27,406	25,190	22,365
Surplus (Need)	2,056	(255)	1,228	589	821	(2,135)	(2,962)	(62)	(223)	2,052	6,877	3,325	1,076

[1/] Loads net of conservation.

Table 3: *Northwest Region Requirements and Resources – Winter Peak*

The sum of the individual utilities' firm requirements and resources for the peak hour in January for each of the next 10 years are shown in this table. Firm peak requirements include a planning margin to account for planning uncertainties.

Winter Peak (MW)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Firm Requirements										
Load [1/]	32,292	32,609	32,670	32,917	33,128	33,416	33,534	33,758	33,703	33,934
Exports	1,379	1,350	1,332	1,326	1,325	1,325	1,325	1,325	1,325	1,325
Planning Margin [2/]	3,875	4,239	4,574	4,937	5,300	5,681	6,036	6,414	6,741	6,787
Total	37,546	38,198	38,576	39,181	39,753	40,422	40,895	41,498	41,769	42,046
Firm Resources										
Hydro	22,357	22,264	22,264	22,256	22,256	22,256	22,256	22,256	22,256	22,256
Demand Response	87	89	90	92	93	88	89	90	90	90
Small Therm & Misc.	3	3	3	3	3	3	3	3	3	3
Natural Gas	6,574	6,904	6,904	6,904	6,904	,904	6,904	6,904	6,904	6,904
Renewables-Other	243	243	243	243	242	239	233	233	233	233
Solar	1	1	1	1	1	1	1	1	1	1
Wind	222	222	222	222	222	222	203	205	204	201
Cogeneration	78	64	64	64	43	43	14	9	9	9
Imports	1,643	1,556	1,548	1,514	1,525	1,537	1,550	1,562	1,576	1,505
Nuclear	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120
Coal	4,294	4,291	4,291	4,291	4,291	3,721	3,718	3,715	3,715	3,715
Total	36,621	36,755	36,749	36,708	36,698	36,133	36,089	36,096	36,110	36,035
Surplus (Need)	(925)	(1,443)	(1,827)	(2,472)	(3,055)	(4,288)	(4,807)	(5,401)	(5,659)	(6,011)

[1/] Loads net of conservation.
[2/] Planning Margin accounts for forced outages, unanticipated load growth, load variation due to temperatures, and operating reserves.

Table 4: *Northwest Region Requirements and Resources – Summer Peak*

This table shows the sum of the individual utilities' firm requirements and resources for a peak hour in August for each of the next 10 years. Firm peak requirements include a planning margin to account for planning uncertainties.

Summer Peak (MW)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Firm Requirements										
Load [1/]	27,420	27,620	27,954	28,071	28,292	28,473	28,649	28,823	29,056	29,414
Exports	1,979	1,839	1,857	1,764	1,754	1,754	1,454	1,454	1,454	1,447
Planning Margin [2/]	3,290	3,591	3,914	4,211	4,527	4,840	5,157	5,476	5,811	5,883
Total	32,690	33,050	33,724	34,046	34,574	35,068	35,261	35,753	36,322	36,743
Firm Resources										
Hydro	20,976	20,883	20,883	20,875	20,875	20,875	20,875	20,875	20,875	20,875
Demand Response	394	405	407	408	410	405	405	406	406	406
Small Therm & Misc.	3	3	3	3	3	3	3	3	3	3
Natural Gas	5,928	6,358	6,358	6,358	6,358	6,358	6,358	6,358	6,358	6,358
Renewables-Other	246	244	245	245	245	243	241	235	235	235
Solar	1	1	234	234	234	234	234	234	234	234
Wind	224	224	224	224	224	223	223	205	205	203
Cogeneration	61	47	47	47	47	29	5	5	0	0
Imports	1,073	1,130	1,132	1,142	1,152	1,162	1,173	1,183	1,193	1,200
Nuclear	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120
Coal	4,298	4,294	4,291	4,291	4,291	4,291	3,721	3,718	3,715	3,715
Total	34,324	34,709	34,944	34,947	34,958	34,943	34,358	34,341	34,344	34,349
Surplus (Need))	1,634	1,659	1,220	901	385	(125)	(903)	(1,412)	(1,977)	(2,395)

[1/] Loads net of conservation.

[2/] Planning Margin accounts for forced outages, unanticipated load growth, load variation due to temperatures, and operating reserves.

Northwest New and Existing Resources

Table 5: *Recently Acquired Resources* highlights projects that have most recently become available.

Project	Date	Fuel/ Tech	Name plate (MW)	Winter Peak (MW)	Summer Peak (MW)	Energy (MWa)	Utility
Black Canyon Bliss Dam	Nov-14	hydro	0	-	-	-	Idaho Power
Box Canyon Upgrade (Unit 1)	Dec-14	hydro	6	1	1		Pend Oreille County PUD
Clark Canyon Dam	Mar-14	hydro	8	0	1		Idaho Power
Coal Transition PPA	Dec-14	contract	380	380	380	380	Puget Sound Energy
Kerr Dam		hydro	247	211	211	179	NorthWestern Energy
Plum Creek NLSL Green Exception/Off-Site Renewable	Jul-14	biomass	6	6	6	6	Flathead Electric Cooperative
Port Westward 2	Dec-14	natural gas	220	220	220		Portland General Electric
Thompson Falls Dam 7 units		hydro	115	94	94	85	NorthWestern Energy
Tucannon River Wind	Dec-14	wind	267	13	13	102	Portland General Electric
W10 Generator Replacement	May-14	hydro	23	23	23	-	Grant County PUD
Total			1,271	949	950	752	

Table 6a: *Committed New Supply* lists contracts and generating projects where construction has started and that utilities are counting on to meet need. All supply listed in these tables are included in the regional analysis of power needs.

Project	Date	Fuel/ Tech	Name plate (MW)	Winter Peak (MW)	Summer Peak (MW)	Energy (MWa)	Utility
American Falls Solar	Jan-16	solar	20	0	11	5	Idaho Power
American Falls Solar II	Jan-16	solar	20	0	11	5	Idaho Power
Benson Creek Wind	Dec-16	wind	10	1	1	2	Idaho Power
Boise City	Jul-16	solar	40	0	21	12	Idaho Power
Calligan Creek	Jan-17	hydro	6	6	2	2	Snohomish PUD
Carty CCCT	Jun-16	natural gas	440	430	430	360	Portland General Electric
Clark Solar 1	Dec-16	solar	71	0	38	21	Idaho Power
Clark Solar 2	Dec-16	solar	20	0	11	6	Idaho Power
Clark Solar 3	Dec-16	solar	30	0	16	9	Idaho Power
Clark Solar 4	Dec-16	solar	20	0	11	6	Idaho Power
Durbin Creek Wind	Dec-16	wind	10	1	1	2	Idaho Power
Grand View Solar	Jul-16	solar	40	0	33	20	Idaho Power
Grove Solar	Dec-16	solar	10	0	5	2	Idaho Power
Hancock Creek	Nov-17	hydro	6	6	3	2	Snohomish PUD
Head of U Canal	May-15	hydro	1	0	1		Idaho Power
Hyline Solar	Dec-16	solar	10	0	5	2	Idaho Power
Jett Creek Wind	Dec-16	wind	10	1	1	2	Idaho Power
Little Wood River Ranch II	Jun-15	hydro	1	0	1		Idaho Power
Mountain Home Solar	Dec-16	solar	20	0	11	7	Idaho Power
Murphy Flat Power	Dec-16	solar	20	0	11	5	Idaho Power
Open Range Solar	Dec-16	solar	10	0	5	2	Idaho Power
Orchard Ranch Solar	Dec-16	solar	20	0	11	5	Idaho Power
Pocatello Solar I	Dec-16	solar	20	0	10	6	Idaho Power
Prospector Wind	Dec-16	wind	10	1	1	3	Idaho Power
Railroad Solar	Dec-16	solar	10	0	5	2	Idaho Power
Simco Solar	Dec-16	solar	20	0	11	5	Idaho Power
Solar	Dec-15	solar	8	0	1	2	PacifiCorp
Thunderegg Solar	Dec-16	solar	10	0	5	2	Idaho Power
Vale Solar	Dec-16	solar	10	0	5	2	Idaho Power
W09 Generator E Replacement	Jun-15	hydro	21	21	21		Grant County PUD
W09 Transformer E Replacement	Nov-14	hydro	23	23	23		Grant County PUD
W10 Transformer E Replacement	Nov-14	hydro	21	21	21		Grant County PUD
Willow Springs Wind Farm	Dec-16	wind	10	1	1	2	Idaho Power
Total			999	510	743	505	

Table 6b: *Demand Side Management Programs* is a snapshot of the regional utilities' efforts to manage demand. The majority of the reported conservation savings are from energy efficiency and distribution efficiency. Some utilities also include some savings from market transformation, fuel switching, fuel conversion or energy storage. This table also shows cumulative demand response programs reported by utilities.

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Conservation										
Annual Energy (MWa)										
Incremental	187	181	178	174	166	179	163	156	146	146
Cumulative	187	369	547	721	888	1,067	1,230	1,386	1,532	1,678
Winter Peak (MW)										
Incremental	256	246	239	238	185	269	209	209	202	152
Cumulative	256	503	741	979	1,163	1,432	1,641	1,851	2,053	2,205
Demand Response (MW)										
Winter	87	89	90	92	93	88	89	90	90	90
Summer	394	405	407	408	410	405	405	406	406	406

Table 7: ***Planned Resources*** captures resources utilities have identified to meet their own needs. The table shows planned generating projects that are being counted on to meet the growing demand. This information is a compilation of what utilities have reported in their individual integrated resources plans. These resources are not included in the regional analysis of power needs.

Project	Schedule	Fuel/ Tech	Name plate (MW)	Winter Peak (MW)	Summer Peak (MW)	Energy (MWa)	Utility
Benson Creek Wind	Dec-16	wind	10	10	10		Idaho Power
Biomass	Dec-23	wood waste	44			40	Seattle City Light
Combined Heat &Power	Dec-18	CHP	4		4	4	PacifiCorp
Combined Heat & Power	Dec-22	CHP	3		3	3	PacifiCorp
Durbin Creek Wind	Dec-16	wind	10	10	10		Idaho Power
Gas peaker	Dec-17	natural gas	221	221	221		Puget Sound Energy
Gas peaker	Dec-19	natural gas	83	76	76		Avista Corp.
Gas peaker	Dec-23	natural gas	221	221	221		Puget Sound Energy
Gas peaker	Dec-23	natural gas	83	76	76		Avista Corp.
Gas peaker	Dec-24	natural gas	221	221	221		Puget Sound Energy
Landfill Gas	Dec-20	methane/ gas engine	9			8	Seattle City Light
Nine Mile 1 & 2	Dec-15	hydro		16	13		Avista Corp.
Prospector Wind	Dec-16	wind	10	10	10		Idaho Power
Shoshone Falls Upgrade	Jul-19	hydro	49	2	9		Idaho Power
Small Hydro	Jan-24	hydro	30				Snohomish Co. PUD
Solar	Dec-15	solar	8			2	PacifiCorp
W 06 Generator Replacement	Mar-16	hydro	9	9	9		Grant County PUD
W03 Generator Replacement	Dec-16	hydro	9	9	9		Grant County PUD
W04 Generator Replacement	Sep-17	hydro	9	9	9		Grant County PUD
W07 Transformer D Replacement	May-15	hydro	21	21	21		Grant County PUD
W08 Generator Replacement	Jul-18	hydro	9	9	9		Grant County PUD
W08 Transformer D Replacement	May-15	hydro	12	12	12		Grant County PUD
Wind	Dec-23	wind	63			20	Seattle City Light
Wind	Dec-24	wind	220			70	Seattle City Light
Wind	Dec-25	wind	31			10	Seattle City Light
Total			1,388	931	941	157	

Table 8a: ***Northwest Utility Generating Resources*** is a comprehensive list of utility-owned and utility contracted generating resources that make up those utilities electric power supply.

Project	Owner	NW Utility	Nameplate (MW)
HYDRO			33,128
Albeni Falls	US Corps of Engineers	Federal System (BPA)	43
Alder	Tacoma Power	Tacoma Power	50
American Falls	Idaho Power	Idaho Power	92
Anderson Ranch	US Bureau of Reclamation	Federal System (BPA)	40
Arena Drop		Idaho Power	0
Arrowrock Dam	Clatskanie PUD/Irr Dist	Clatskanie PUD	18
B. Smith	PacifiCorp	PacifiCorp	0
Barber Dam	Enel North America	Idaho Power	4
Bell Mountain	PacifiCorp	PacifiCorp	1
Big Cliff	US Corps of Engineers	Federal System (BPA)	18
Big Sheep Creek	Everand Jensen	Avista Corp.	0
Birch Creek	Everand Jensen	Idaho Power	0
Birch Creek	PacifiCorp	PacifiCorp	3
Black Canyon Bliss Dam	PURPA	Idaho Power	0
Black Canyon	US Bureau of Reclamation	Federal System (BPA)	10
Black Canyon # 3	Big Wood Canal Co.	Idaho Power	0
Black Creek Hydro	Black Creek Hydro, Inc.	Puget Sound Energy	4
Blind Canyon	Blind Canyon Hydro	Idaho Power	2
Bliss	Idaho Power	Idaho Power	75
Boise River Diversion	US Bureau of Reclamation	Federal System (BPA)	2
Bonneville	US Corps of Engineers	Federal System (BPA)	1,102
Boston Power		PacifiCorp	
Boundary	Seattle City Light	Seattle City Light	1,040
Box Canyon	Pend Oreille County PUD	Pend Oreille County PUD	70
Box Canyon-Idaho	Richard Kaster	Idaho Power	0
Briggs Creek	Richard Kaster	Idaho Power	1
Brownlee	Idaho Power	Idaho Power	585
Burnside Hydro		Other Public (BPA)	
Bypass	Bypass, Ltd.	Idaho Power	10
Cabinet Gorge	Avista Corp.	Avista Corp.	265
Calligan Creek	Snohomish County PUD	Snohomish County PUD	6
Calispel Creek	Pend Oreille County PUD	Pend Oreille County PUD	1
Canyon Springs	J.D. McCollum	Idaho Power	0
Carmen-Smith	Eugene Water & Electric Board	Eugene Water & Electric Board	105
Cascade	US Bureau of Reclamation	Idaho Power	12

Project	Owner	NW Utility	Nameplate (MW)
CDM Hydro	PacifiCorp	PacifiCorp	6
Cedar Draw Creek	Crys. Sprgs. Hydro	Idaho Power	2
Cedar Falls, Newhalem	Seattle City Light	Seattle City Light	20
Central Oregon Siphon		PacifiCorp	5
Chandler	US Bureau of Reclamation	Federal System (BPA)	12
Chelan	Chelan County PUD	Chelan County PUD	59
Chief Joseph	US Corps of Engineers	Federal System (BPA)	2,457
C. J. Strike	Idaho Power	Idaho Power	83
Clark Canyon Dam	PURPA	Idaho Power	8
Clear Lake	Idaho Power	Idaho Power	3
Clear Springs Trout	Clear Sprgs. Trout	Idaho Power	1
Clearwater #1	PacifiCorp	PacifiCorp	15
Clearwater #2	PacifiCorp	PacifiCorp	26
Cline Falls	COID	PacifiCorp	1
COID	PacifiCorp	PacifiCorp	7
Copco #1	PacifiCorp	PacifiCorp	20
Copco #2	PacifiCorp	PacifiCorp	27
Cougar	US Corps of Engineers	Federal System (BPA)	25
Cove Hydro		Other Public (BPA)	
Cowlitz Falls	Lewis County PUD	Federal System (BPA)	70
Crystal Springs	Crystal Springs Hydro	Idaho Power	2
Curry Cattle Company	Curry Cattle Co.	Idaho Power	0
Curtis Livestock	PacifiCorp	PacifiCorp	0
Cushman 1	Tacoma Power	Tacoma Power	43
Cushman 2	Tacoma Power	Tacoma Power	81
Deep Creek	Gordon Foster	Avista Corp.	0
Derr Creek	Jim White	Avista Corp.	0
Detroit	US Corps of Engineers	Federal System (BPA)	100
Dexter	US Corps of Engineers	Federal System (BPA)	15
Diablo Canyon	Seattle City Light	Seattle City Light	182
Dietrich Drop	Enel North America	Idaho Power	5
Dry Creek		PacifiCorp	4
D. Wiggins		PacifiCorp	
Dworshak	US Corps of Engineers	Federal System (BPA)	400
Dworshak/ Clearwater		Federal System (BPA)	
Eagle Point	PacifiCorp	PacifiCorp	3
East Side	PacifiCorp	PacifiCorp	3
Eight Mile Hydro	Eightmile Hydro Corporation	Idaho Power	0
Electron	Puget Sound Energy	Puget Sound Energy	23
Esquatzel Small Hydro	Green Energy Today, LLC	Franklin County PUD	1

Project	Owner	NW Utility	Nameplate (MW)
Fall Creek	PacifiCorp	PacifiCorp	3
Falls Creek		Other Public (BPA)	
Falls River	Marysville Hydro Partner	Idaho Power	9
Faraday	Portland General Electric	Portland General Electric	37
Fargo Drop Hydro	Riverside Investments, LLC	Idaho Power	1
Farmers Irrigation	PacifiCorp	PacifiCorp	3
Faulkner Ranch	Faulkner Brothers Hydro Inc.	Idaho Power	1
Fish Creek	PacifiCorp	PacifiCorp	11
Fisheries Development Co.	Fisheries Devel.	Idaho Power	0
Foster	US Corps of Engineers	Federal System (BPA)	20
Frontier Technologies	PacifiCorp	PacifiCorp	4
Galesville Dam	PacifiCorp	PacifiCorp	2
Gem State Hydro		Other Publics (BPA)	23
Geo-Bon No 2	Enel North America, Inc.	Idaho Power	1
Georgetown Power	PacifiCorp	PacifiCorp	0
Gorge	Seattle City Light	Seattle City Light	207
Grand Coulee	US Bureau of Reclamation	Federal System (BPA)	6,494
Green Peter	US Corps of Engineers	Federal System(BPA)	80
Green Springs	US Bureau of Reclamation	Federal System (BPA)	16
Hailey CSPP	City of Hailey	Idaho Power	0
Hancock Creek	Snohomish County PUD	Snohomish County PUD	6
Hazelton A	SE Hazelton ALP	Idaho Power	8
Hazelton B	Hazelton Power Co.	Idaho Power	8
Head of U Canal	PURPA	Idaho Power	1
Hells Canyon	Idaho Power	Idaho Power	392
Hills Creek	US Corps of Engineers	Federal System (BPA)	30
Hood Street Reservoir	Tacoma Power	Tacoma Power	1
Horseshoe Bend	Horseshoe Bend Hydro	Idaho Power	10
Hungry Horse	US Bureau of Reclamation	Federal System (BPA)	428
Hutchinson Creek	STS Hydro	Puget Sound Energy	1
Ice Harbor	US Corps of Engineers	Federal System(BPA)	603
Idaho Falls - City Plant		Federal System (BPA)	
Idaho Falls - Lower Plant		Federal System (BPA)	
Idaho Falls - Upper Plant		Federal System (BPA)	
Ingram Warm Springs	PacifiCorp	PacifiCorp	1
Iron Gate	PacifiCorp	PacifiCorp	18
Island Park		Fall River Rural Electric Cooperative	5
Jackson (Sultan)	Snohomish County PUD	Snohomish County PUD	112
James Boyd		PacifiCorp	
Jim Ford Creek	Ford Hydro	Avista Corp.	2

Project	Owner	NW Utility	Nameplate (MW)
Jim Knight	Big Wood Canal Co.	Idaho Power	0
John C. Boyle	PacifiCorp	PacifiCorp	90
John Day	US Corps of Engineers	Federal System (BPA)	2,160
John Day Creek	Dave Cereghino	Avista Corp.	1
John H Koyle	John H Koyle	Idaho Power	1
Joseph Hydro		PacifiCorp	
Kasel-Witherspoon	Kasel & Witherspoon	Idaho Power	1
Kerr	NorthWestern Corporation	NorthWestern Energy	194
Koma Kulshan	Koma Kulshan Associates	Puget Sound Energy	11
La Grande	Tacoma Power	Tacoma Power	64
Lacomb Irrigation	PacifiCorp	PacifiCorp	1
Lake Creek		Other Publics (BPA)	
Lake Oswego Corp.		Portland General Electric	1
Lateral No. 10	Lateral 10 Ventures	Idaho Power	2
Leaburg	Eugene Water & Electric Board	Eugene Water & Electric Board	16
Lemolo #1	PacifiCorp	PacifiCorp	32
Lemolo #2	PacifiCorp	PacifiCorp	33
Lemoyne	John Lemoyne	Idaho Power	0
Libby	US Corps of Engineers	Federal System(BPA)	525
Lilliwaup Falls		Other Public (BPA)	1
Little Falls	Avista Corp.	Avista Corp.	32
Little Goose	US Corps of Engineers	Federal System(BPA)	810
Little Wood	Little Wood Irr District	Idaho Power	3
Little Wood/Arkoosh	William Arkoosh	Idaho Power	1
Little Wood River Ranch II	PURPA	Idaho Power	1
Lloyd Fery	PacifiCorp	PacifiCorp	0
Long Lake	Avista Corp.	Avista Corp.	70
Lookout Point	US Corps of Engineers	Federal System (BPA)	120
Lost Creek	US Corps of Engineers	Federal System (BPA)	49
Lower Baker	Puget Sound Energy	Puget Sound Energy	115
Lower Granite	US Corps of Engineers	Federal System(BPA)	810
Lower Malad	Idaho Power	Idaho Power	14
Lower Monumental	US Corps of Engineers	Federal System(BPA)	810
Lower Salmon	Idaho Power	Idaho Power	60
Lowline #2	Enel North America, Inc.	Idaho Power	3
Lowline Canal	S. Forks	Idaho Power	3
Lowline Midway	Idaho Power	Idaho Power	8
Lucky Peak	US Corps of Engineers	Seattle City Light	113
Magic Reservoir	Magic Reservoir Hydro	Idaho Power	9
Main Canal Headworks	SEQCBID	Multiple Utilities	26

Project	Owner	NW Utility	Nameplate (MW)
Malad River	V. Ravenscroft	Idaho Power	1
Mayfield	Tacoma Power	Tacoma Power	162
McNary	US Corps of Engineers	Federal System(BPA)	980
McNary Fishway	US Corps of Engineers	Other Publics (BPA)	
Merwin	PacifiCorp	PacifiCorp	136
Meyers Falls	Hydro Technology Systems	Avista Corp.	1
Middlefork Irrigation	PacifiCorp	PacifiCorp	3
Mile 28	Contractors Power Group Inc.	Idaho Power	2
Mill Creek (Cove)	City of Cove, OR	Idaho Power	1
Mill Creek		Other Publics (BPA)	1
Milner	Idaho Power	Idaho Power	59
Minidoka	US Bureau of Reclamation	Federal System (BPA)	28
Mink Creek	PacifiCorp	PacifiCorp	3
Mitchell Butte	Owyhee Irrigation District	Idaho Power	2
Monroe Street	Avista	Avista Corp.	15
Mora Drop	Riverside LLC	Idaho Power	2
Morse Creek		Port Angeles	1
Mossyrock	Tacoma Power	Tacoma Power	300
Mountain Energy	PacifiCorp	PacifiCorp	0
Mount Tabor	City of Portland	Portland General Electric	0
Moyie Springs		Other Publics (BPA)	
Mud Creek/S&S	H.K.Hydro	Idaho Power	1
Mud Creek/White	Mud Creek Hydro	Idaho Power	0
N-32 Canal (Marco Ranches)	Ranchers Irrig., Inc.	Idaho Power	1
Nicols Gap	PacifiCorp	PacifiCorp	1
Nicolson SunnyBar	PacifiCorp	PacifiCorp	0
Nine Mile	Avista Corp.	Avista Corp.	26
Nooksack	Puget Sound Hydro, LLC	Puget Sound Energy	3
North Fork	Portland General Electric	Portland General Electric	41
North Fork Sprague	PacifiCorp	PacifiCorp	1
Noxon Rapids	Avista Corp.	Avista Corp.	466
N.R. Rousch	PacifiCorp	PacifiCorp	0
Oak Grove	Portland General Electric	Portland General Electric	51
Odell Creek	PacifiCorp	PacifiCorp	0
O.J. Power	PacifiCorp	PacifiCorp	0
Opal Springs	PacifiCorp	PacifiCorp	5
Ormsby		PacifiCorp	
Owyhee Dam	Owyhee Irrigation District	Idaho Power	5
Oxbow	Idaho Power Company	Idaho Power	190
Packwood	Energy Northwest	Multiple Utilities	26

Project	Owner	NW Utility	Nameplate (MW)
Palisades	US Bureau of Reclamation	Federal System (BPA)	177
PEC Headworks	SEQCBID	Grant County PUD	7
Pelton	Portland General Electric	Multiple Utilities	110
Pelton Reregulation	Warm Springs Tribe	Portland General Electric	19
Phillips Ranch	Glen Phillips	Avista Corp.	0
Pigeon Cove	Pigeon Cove Power	Idaho Power	2
Portland Hydro-Project	City of Portland	Portland General Electric	36
Portneuf River		PacifiCorp	1
Post Falls	Avista Corp.	Avista Corp.	15
Potholes East Canal 66 Headworks	SEQCBID	Multiple Utilities	5
Powerdale	PacifiCorp	PacifiCorp	6
Preston City	PacifiCorp	PacifiCorp	0
Priest Rapids	Grant County PUD	Multiple Utilities	956
Pristine Springs	Pristine Springs, Inc	Idaho Power	0
Pristine Springs #3	Pristine Springs, Inc	Idaho Power	0
Prospect #1	PacifiCorp	PacifiCorp	4
Prospect #2	PacifiCorp	PacifiCorp	32
Prospect #3	PacifiCorp	PacifiCorp	7
Prospect #4	PacifiCorp	PacifiCorp	1
Quincy Chute	SEQCBID	Grant County PUD	9
R.D. Smith	SEQCBID	Multiple Utilities	6
Reeder Gulch		Other Publics (BPA)	0
Reynolds Irrigation	Reynolds Irr.	Idaho Power	0
Rim View	Rim View Trout Co.	Idaho Power	0
River Mill	Portland General Electric	Portland General Electric	19
Rock Creek No. 1	Rock Creek Joint	Idaho Power	2
Rock Creek No. 2	Enel North America	Idaho Power	2
Rocky Brook	Mason County PUD #3	Other Public (BPA)	2
Rock Island	Chelan County PUD	Multiple Utilities	629
Rocky Reach	Chelan County PUD	Multiple Utilities	1300
Ross	Seattle City Light	Seattle City Light	360
Round Butte	Portland General Electric	Multiple Utilities	247
Roza	US Bureau of Reclamation	Federal System (BPA)	13
Sagebrush	Big Wood Canal Co.	Idaho Power	0
Sahko	Sahko	Idaho Power	1
Santiam	PacifiCorp	PacifiCorp	0
Schaffner	Lemhi Hydro Co.	Idaho Power	1
Sheep Creek	Glen Phillips	Avista Corp.	2
Shingle Creek	Willis D Deveny	Idaho Power	0
Shoshone II	Shorock Hydro	Idaho Power	1

Project	Owner	NW Utility	Nameplate (MW)
Shoshone CSPP	Shorock Hydro, Inc.	Idaho Power	0
Shoshone Falls	Idaho Power	Idaho Power	13
Slide Creek	PacifiCorp	PacifiCorp	18
Smith Creek	Eugene Water & Electric Board	Eugene Water & Electric Board	38
Snake River Pottery	Snake River Pottery	Idaho Power	0
Snedigar Ranch	David Snedigar	Idaho Power	1
Snoqualmie Falls	Puget Sound Energy	Puget Sound Energy	54
Soda Creek		Other Publics (BPA)	
Soda Springs	PacifiCorp	PacifiCorp	11
South Fork Tolt	Seattle City Light	Seattle City Light	17
Spokane Upriver	City of Spokane	Avista Corp.	16
Stauffer Dry Creek		PacifiCorp	
Steffen Hydro		Snohomish County PUD	
Stone Creek	Eugene Water & Electric Board	Eugene Water & Electric Board	12
Strawberry Creek	South Idaho Public Agency	Other Publics (BPA)	
Summer Falls	SEQCBID	Multiple Utilities	92
Swan Falls	Idaho Power	Idaho Power	25
Swift 1	PacifiCorp	Multiple Utilities	219
Swift 2	Cowlitz County PUD	Multiple Utilities	0
Sygitowicz	Cascade Clean Energy	Puget Sound Energy	0
TGS/Briggs		PacifiCorp	
The Dalles	US Corps of Engineers	Federal System(BPA)	1,807
The Dalles Fishway	Northern Wasco Co. PUD	Northern Wasco Co. PUD	5
Thompson Falls	NorthWestern Corporation	NorthWestern Energy	94
Thousand Springs	Idaho Power	Idaho Power	9
Tiber Dam	Tiber Montana, LLC	Idaho Power	8
Toketee	PacifiCorp	PacifiCorp	43
Trail Bridge	Eugene Water & Electric Board	Eugene Water & Electric Board	10
Trout Company	Branch Flower Co.	Idaho Power	0
Tunnel #1	Owyhee Irrig. Dist.	Idaho Power	7
Twin Falls	Idaho Power	Idaho Power	53
Twin Falls	Twin Falls Hydro Association LP	Puget Sound Energy	20
TW Sullivan	Portland General Electric	Portland General Electric	15
Upper Baker	Puget Sound Energy	Puget Sound Energy	105
Upper Falls	Avista Corp.	Avista Corp.	10
Upper Malad	Idaho Power	Idaho Power	8
Upper Salmon 1 & 2	Idaho Power	Idaho Power	18
Upper Salmon 3 & 4	Idaho Power	Idaho Power	17
Walla Walla	PacifiCorp	PacifiCorp	2
Wallowa Falls	PacifiCorp	PacifiCorp	1

Project	Owner	NW Utility	Nameplate (MW)
Walterville	Eugene Water & Electric Board	Eugene Water & Electric Board	8
Wanapum	Grant County PUD	Multiple Utilities	934
Weeks Falls	So. Fork II Assoc. LP	Puget Sound Energy	5
Wells	Douglas County PUD	Multiple Utilities	774
West Side	PacifiCorp	PacifiCorp	1
White Water Ranch	White Water Ranch	Idaho Power	0
Wilson Lake Hydro	Wilson Pwr. Co.	Idaho Power	8
Woods Creek	Snohomish County PUD	Snohomish County PUD	1
Wynoochee	Tacoma Power	Tacoma Power	13
Yale	PacifiCorp	PacifiCorp	134
Yelm		Other Publics (BPA)	12
Yakima-Tieton	PacifiCorp	PacifiCorp	3
Young's Creek	Snohomish County PUD	Snohomish County PUD	8
COAL			5,496
Boardman	Portland General Electric	Multiple Utilities	642
Colstrip #1	PP&L Montana, LLC	Multiple Utilities	330
Colstrip #2	PP&L Montana, LLC	Multiple Utilities	330
Colstrip #3	PP&L Montana, LLC	Multiple Utilities	740
Colstrip #4	NorthWestern Energy	Multiple Utilities	805
Jim Bridger #1	PacifiCorp / Idaho Power	Multiple Utilities	540
Jim Bridger #2	PacifiCorp / Idaho Power	Multiple Utilities	540
Jim Bridger #3	PacifiCorp / Idaho Power	Multiple Utilities	540
Jim Bridger #4	PacifiCorp / IPC	Multiple Utilities	508
Valmy #1	NV Energy / Idaho Power	Multiple Utilities	254
Valmy #2	NV Energy / Idaho Power	Multiple Utilities	267
NUCLEAR			1,230
Columbia Generating Station	Energy Northwest	Federal System (BPA)	1,230

Project	Owner	NW Utility	Nameplate (MW)
NATURAL GAS			6,928
Alden Bailey	Clatskanie PUD	Clatskanie PUD	11
Beaver	Portland General Electric	Portland General Electric	516
Beaver 8	Portland General Electric	Portland General Electric	25
Bennett Mountain	Idaho Power	Idaho Power	173
Boulder Park	Avista Corp.	Avista Corp.	25
Carty	Portland General Electric	Portland General Electric	440
Chehalis Generating Facility	PacifiCorp	PacifiCorp	517
Coyote Springs I	Portland General Electric	Portland General Electric	266
Coyote Springs II	Avista Corp.	Avista Corp.	287
Danskin	Idaho Power	Idaho Power	92
Danskin 1	Idaho Power	Idaho Power	179
Dave Gates Generating Station	NorthWestern Energy	NorthWestern Energy	150
Encogen	Puget Sound Energy	Puget Sound Energy	159
Ferndale Cogen Station (Tenaska)	Puget Sound Energy	Puget Sound Energy	245
Frederickson Generation Station	EPCOR Power L.P./PSE	Multiple Utilities	258
Fredonia 1 & 2	Puget Sound Energy	Puget Sound Energy	208
Fredonia 3 & 4	Puget Sound Energy	Puget Sound Energy	108
Fredrickson 1 & 2	Puget Sound Energy	Puget Sound Energy	149
Goldendale Generating Station	Puget Sound Energy	Puget Sound Energy	261
Hermiston Generating Project	PacifiCorp/Hermiston Gen. Co,	PacifiCorp	469
Kettle Falls CT	Avista Corp.	Avista Corp.	7
Klamath Peaking Units 1-4	Iberdrola Renewables	Puget Sound Energy	100
Lancaster Power Project	Avista Corp.	Avista Corp.	270
Langley Gulch	Idaho Power	Idaho Power	319
Mint Farm Energy Center	Puget Sound Energy	Puget Sound Energy	305
Northeast A&B	Avista Corp.	Avista Corp.	62
Port Westward	Portland General Electric	Portland General Electric	415
Port Westward Unit 2	Portland General Electric	Portland General Electric	220
Rathdrum 1 & 2	Avista Corp.	Avista Corp.	167
River Road Generating Project	Clark Public Utilities	Clark Public Utilities	248
Rupert (Magic Valley)	Rupert Illinois Holdings	Idaho Power	10
Sumas Energy	Puget Sound Energy	Puget Sound Energy	121
Whitehorn #2 & 3	Puget Sound Energy	Puget Sound Energy	149

Project	Owner	NW Utility	Nameplate (MW)
COGENERATION			199
Billings Cogeneration	Billings Generation, Inc.	NorthWestern Energy	64
Hampton Lumber		Snohomish County PUD	5
International Paper Energy Center	Eugene Water & Electric Board	Eugene Water & Electric Board	26
James River - Camas	PacifiCorp	PacifiCorp	52
Simplot-Pocatello	PURPA	Idaho Power	12
Tasco-Nampa	Tasco	Idaho Power	2
Tasco-Twin Falls	Tasco	Idaho Power	3
Wauna (James River)	Western Generation Agency	Mutiple Utilities	36
RENEWABLES-OTHER			346
Bettencourt B6	Cargill	Idaho Power	2
Bettencourt Dry Creek	Cargill	Idaho Power	2
Big Sky West Dairy	Dean Foods Co. & AgPower Partners LLC	Idaho Power	2
Bio Energy		Puget Sound Energy	1
Bio Fuels, WA		Puget Sound Energy	5
Biomass One	PacifiCorp	PacifiCorp	25
City of Spokane Waste to Energy	City of Spokane	Avista Corp.	26
Coffin Butte Resource Project	Power Resources Cooperative	PNGC Power	6
Cogen Company	Prairie Wood Products Co-Gen Co.	Oregon Trail Cooperative	8
Co-Gen II - DR Johnson Lumber	PacifiCorp	PacifiCorp	8
Columbia Ridge Landfill Gas	Waste Management	Seattle City Light	13
Convanta Marion	Portland General Electric	Portland General Electric	16
Double A Digestor	PURPA-Andgar Corp	Idaho Power	5
Dry Creek Landfill	Dry Creek Landfill Inc.	PacifiCorp	3
Edaleen Dairy		Puget Sound Energy	1
Farm Power Tillamook	Tillamook	Tillamook	1
Fighting Creek	Kootenai Electric Co-op	Idaho Power	3
Flathead County Landfill	Flathead Electric Cooperative	Flathead Electric Cooperative	2
Four Mile Hill Geothermal	Calpine	Federal System (BPA)	50
Hidden Hollow Landfill	G2 Energy	Idaho Power	3
Hooley Digester	Tillamook PUD	Tillamook PUD	1
H. W. Hill Landfill	Allied Waste Companies	Multiple Utilities	11
Interfor Pacific-Gilchrist	Midstate Electric Cooperative	Midstate Electric Cooperative	
Kettle Falls	Avista Corp.	Avista Corp.	51
Lynden	Farm Power	Puget Sound Energy	1
Mill Creek (Cove)		Idaho Power	1
Neal Hot Springs	U.S Geothermal	Idaho Power	23

Project	Owner	NW Utility	Nameplate (MW)
Olympic View 1&2	Mason County PUD #3	Mason County PUD #3	5
Pine Products	PacifiCorp	PacifiCorp	6
Plum Creek NLSL	Plum Creek MDF	Flathead Electric Cooperative	6
Pocatello Wastewater	Idaho Power	Idaho Power	0
Portland Wastewater	City of Portland	Portland General Electric	2
Raft River 1	US Geothermal	Idaho Power	16
Rainier Biogas		Puget Sound Energy	1
Rexville	Farm Power	Puget Sound Energy	1
River Bend Landfill	McMinnville Water & Light	McMinnville Water & Light	0
Rock Creek Dairy	PURPA	Idaho Power	4
Seneca	Seneca Sustainable Energy, LLC	Eugene Water & Electric Board	20
Short Mountain		Emerald PUD	3
Skookumchuck		Puget Sound Energy	1
Smith Creek		Puget Sound Energy	0
Stimson Lumber	Stimson Lumber	Avista Corp.	7
Stoltze Biomass	F.H. Stoltze Land & Lumber	Flathead Electric Cooperative	3
Tamarack	Idaho Power	Idaho Power	5
Van Dyk		Puget Sound Energy	0
VanderHaak Dairy	VanderHaak Dairy, LLC	Puget Sound Energy	0
Whitefish Hydro	Citiy of Whitefish	Ftathead Electric Cooperative	0
SOLAR			445
Ashland Solar Project		Federal System (BPA)	0
American Falls Solar	PURPA	Idaho Power	20
American Falls Solar II	PURPA	Idaho Power	20
Bellevue Solar	EDF Renewable Energy	Portland General Electric	2
Boise City Solar	PURPA	Idaho Power	40
Clark Solar 1	PURPA	Idaho Power	71
Clark Solar 2	PURPA	Idaho Power	20
Clark Solar 3	PURPA	Idaho Power	20
Clark Solar 4	PURPA	Idaho Power	20
Finn Hill Solar (Lake Wash SD)		Puget Sound Energy	0
Grand View Solar	PURPA	Idaho Power	80
Grove Solar	PURPA	Idaho Power	10
Hyline Solar Center	PURPA	Idaho Power	10
Island Solar		Puget Sound Energy	0
King Estate Solar	Lane County Electric Cooperative	Lane County Electric Cooperative	0
Mountain Home Solar	PURPA	Idaho Power	20
Murphy Flat Power	PURPA	Idaho Power	20

Project	Owner	NW Utility	Nameplate (MW)
Open Range Solor Center	PURPA	Idaho Power	10
Orchard Ranch Solar	PURPA	Idaho Power	10
Pocatello Solar I	PURPA	Idaho Power	20
Railroad Solar Center	PURPA	Idaho Power	10
Simco Solar	PURPA	Idaho Power	20
Thunderegg Solar Center	PURPA	Idaho Power	10
Vale Air Solar Center	PURPA	Idaho Power	10
Wild Horse Solar Project	Puget Sound Energy	Puget Sound Energy	1
Yamhill Solar	EDF Renewable Energy	Portland General Electric	1
WIND			4,451
3Bar-G Wind		Puget Sound Energy	1
Bennet Creek	Bennet Creek	Idaho Power	21
Benson Creek Wind	PURPA	Idaho Power	10
Big Top	Big Top LLC (QF)	PacifiCorp	2
Biglow Canyon - 1	Portland General Electric	Portland General Electric	125
Biglow Canyon - 2	Portland General Electric	Portland General Electric	150
Biglow Canyon - 3	Portland General Electric	Portland General Electric	174
Burley Butte Wind Farm	PURPA	Idaho Power	21
Butter Creek Power	Butter Creek Power LLC	PacifiCorp	5
Camp Reed Wind Park	PURPA	Idaho Power	23
Cassia Wind Farm	Cassia Wind Farm	Idaho Power	11
Coastal Energy	CCAP	Grays Harbor PUD	6
Cold Springs	PURPA	Idaho Power	23
Combine Hills I	Eurus Energy of America	PacifiCorp	41
Combine Hills II	Eurus Energy of America	Clark Public Utilities	63
Condon Wind	Goldman Sachs (75%), SeaWest NW (25%)	Federal System (BPA)	25
Desert Meadow Windfarm	PURPA	Idaho Power	23
Durbin Creek	PURPA	Idaho Power	10
Elkhorn Wind	Telocaset Wind Power Partners	Idaho Power	101
Foote Creek Rim 1	PacifiCorp & EWEB	Multiple Utilities	41
Foote Creek Rim 2	PPM Energy	Federal System (BPA)	2
Foote Creek Rim 4	PPM Energy	Federal System (BPA)	17
Fossil Gulch Wind	Idaho Power Company	Idaho Power	11
Four Corners Windfarm	Four Corners Windfarm LLC	PacifiCorp	10
Four Mile Canyon Windfarm	Four Mile Canyon Windfarm LLC	PacifiCorp	10
Golden Valley Wind Farm	PURPA	Idaho Power	12
Goodnoe Hills	PacifiCorp	PacifiCorp	94
Hammett Hill Windfarm	PURPA	Idaho Power	23

Project	Owner	NW Utility	Nameplate (MW)
Harvest Wind	Summit Power	Multiple Utilities	99
Hay Canyon Wind	Hay Canyon Wind Project LLC (Iberdrola)	Snohomish County PUD	101
High Mesa Wind	PURPA	Idaho Power	40
Hopkins Ridge	Puget Sound Energy	Puget Sound Energy	157
Horseshoe Bend	Horseshoe Bend Wind Park LLC	Idaho Power	9
Hot Springs Wind	Hot Springs Wind	Idaho Power	21
Jett Creek	PURPA	Idaho Power	10
Judith Gap	Invenergy Wind, LLC	NorthWestern Energy	135
Klondike I	PPM Energy	Federal System (BPA)	24
Klondike II	PPM Energy	Portland General Electric	75
Klondike III	PPM Energy	Multiple Utilities	221
Knudson Wind		Puget Sound Energy	0
Leaning Juniper 1	PPM Energy	PacifiCorp	101
Lime Wind Energy	PURPA	Idaho Power	3
Lower Snake River 1	Puget Sound Energy	Puget Sound Energy	342
Mainline Windfarm	PURPA	Idaho Power	23
Marengo	Renewable Energy America	PacifiCorp	140
Marengo II	PacifiCorp	PacifiCorp	70
Milner Dam Wind Farm	PURPA	Idaho Power	20
Moe Wind	Two Dot Wind	NorthWestern Energy	1
Nine Canyon	Energy Northwest	Multiple Utilities	96
Oregon Trail Windfarm	Oregon Trail Windfarm LLC	PacifiCorp	10
Oregon Trails Wind Farm	PURPA	Idaho Power	14
Pa Tu Wind Farm	Pa Tu Wind Farm, LLC	Portland General Electric	9
Pacific Canyon Windfarm	Pacific Canyon Windfarm LLC	PacifiCorp	8
Palouse Wind	Palouse Wind, LLC	Avista Corp.	105
Paynes Ferry Wind Park	PURPA	Idaho Power	21
Pilgrim Stage Station Wind Farm	PURPA	Idaho Power	11
Prospector Wind	PURPA	Idaho Power	10
Rockland Wind	PURPA	Idaho Power	80
Ryegrass Windfarm	PURPA	Idaho Power	23
Salmon Falls Wind Farm	PURPA	Idaho Power	22
Sand Ranch Windfarm	Sand Ranch Windfarm LLC	PacifiCorp	10
Sawtooth Wind	PURPA	Idaho Power	21
Sheep Valley Ranch	Two Dot Wind	NorthWestern Energy	1
Stateline Wind	NextEra	Multiple Utilities	300
Swauk Wind		Puget Sound Energy	4
Thousand Springs Wind Farm	PURPA	Idaho Power	12
Three Mile Canyon	Momentum RE	PacifiCorp	10
Tuana Gulch Wind Farm	PURPA	Idaho Power	11

Project	Owner	NW Utility	Nameplate (MW)
Tucannon	Portland General Electric	Portland General Electric	267
Two Ponds Windfarm	PURPA	Idaho Power	23
Vansycle Ridge	ESI Vansycle Partners	Portland General Electric	25
Wagon Trail Windfarm	Wagon Trail Windfarm LLC	PacifiCorp	3
Ward Butte Windfarm	Ward Butte Windfarm LLC	PacifiCorp	7
Wheat Field Wind Project	Wheat Field Wind LLC (Horizon Energy/EDP)	Snohomish County PUD	97
White Creek	White Creek Wind I LLC	Multiple Utilities	205
Wild Horse	Puget Sound Energy	Puget Sound Energy	273
Willow Springs Wind Farm	PURPA	Idaho Power	10
Wolverine Creek	Invenergy	PacifiCorp	65
Yahoo Creek Wind Park	PURPA	Idaho Power	21
SMALL THERMAL AND MISCELLANEOUS			3
Crystal Mountain	Puget Sound Energy	Puget Sound Energy	3

Table 8b: ***Independent Owned Generating Resources*** is a comprehensive list of independently owned electric power supply located in the region and serving utilities outside the region or available for utility-owned to purchase or contract with.

Project	Owner	Nameplate (MW)
COAL		1,340
Centralia #1	TransAlta	670
Centralia #2	TransAlta	670
NATURAL GAS		1,540
Grays Harbor (Satsop)	Invenergy	650
Hermiston Power Project	Hermiston Power Partners (Calpine)	689
Klamath Cogen Plant	Iberdrola Renewables	503
March Point 1	March Point Cogen	80
March Point 2	March Point Cogen	60
Pasco Generation Station		44
COGENERATION		103
Boise Cascade		9
Freres Lumber	Evergreen BioPower	10
Rough & Ready Lumber	Rough & Ready	1
Warm Springs Forest Products		8

Project	Owner	Nameplate (MW)
RENEWABLES-OTHER		26
Spokane MSW	City of Spokane	23
Treasure Valley		3
WIND		3,247
Big Horn	Iberdrola Renewables	199
Big Horn-Phase 2	Iberdrola Renewables	50
Cassia Gulch	John Deere	21
Glacier Wind - Phase 1	Naturener	107
Glacier Wind - Phase 2	Naturener	104
Goshen North	Ridgeline Energy	125
Juniper Canyon - Phase 1	Iberdrola Renewables	151
Kittitas Valley	Horizon	101
Klondike IIIa	Iberdrola Renewables	77
Lava Beds Wind		18
Leaning Juniper II-North	Iberdrola Renewables	90
Leaning Juniper II-South	Iberdrola Renewables	109
Linden Ranch	NW Wind Partners	50
Magic Wind Park		20
Martinsdale Colony North	Two Dot Wind	1
Martinsdale Colony South	Two Dot Wind	2
Notch Butte Wind		18
Pebble Springs Wind	Iberdrola Renewables	99
Rattlesnake Rd Wind (aka Arlington)	Horizon Wind	103
Shepards Flat Central	Caithness Energy	290
Shepards Flat North	Caithness Energy	265
Shepards Flat South	Caithness Energy	290
Stateline Wind	NextEra	300
Vancycle II (Stateline III)	NextEra	99
Vantage Wind	Invenergy	90
Willow Creek	Invenergy	72
Windy Flats	Cannon Power Group	262
Windy Point	Tuolumne Wind Project Authority	137
SMALL THERMAL AND MISCELLANEOUS		44
Colstrip Energy LP Coal	Colstrip Energy Limited Partnership	44

Report Procedures

This report provides an estimate of regional 'need to acquire' generating resources using annual energy (August through July), monthly energy, winter peak-hour and summer peak-hour metrics. The peak need reflects information for January and August, as they present the greatest need for their respective seasons. These metrics provide a multi-dimensional look at the Northwest's need for power and underscore the growing complexity of the power system.

This regional report reflects the summation of individual utilities' forecasts. The larger utilities, in most cases, prepared their own projections. BPA provides much of the information for its smaller customers. Load (i.e. electricity demand), and resource information is included for the utilities listed in Table 9 at the end of this section. Procedures employed in preparing the regional load-resource comparisons of winter and summer peak and energy are described here. A list of definitions is included at the end of this section.

Load Estimate

Regional loads are the sum of loads estimated by the Northwest utilities and BPA for its federal agency customers, certain non-generating public utilities, and direct service industrial customers (DSI). Estimates are made for system peak and system energy loads. Load projections reflect network transmission and distribution losses, reductions in demand due to rising electricity prices, and the effects of appliance efficiency standards and energy building codes. Savings from demand-side management programs, such as energy efficiency, are also reflected in the regional load forecasts.

Energy Loads

A ten-year forecast of monthly firm energy loads is provided. This forecast reflects normal weather conditions. The tabulated information includes the annual average load for the year forecast period as well as the monthly load for the first year of the report.

Peak Loads

Northwest regional peak loads are provided for each month of the ten year forecast period. The tabulated loads for winter and summer peak are the highest estimated 60-minute clock-hour average demand for that month, assuming normal weather conditions. The regional firm peak load is the sum of the individual utility peak loads, and does not account for the fact that each utility may experience its peak load at a different hour than other Northwest utilities. Hence the regional peak load is considered non-coincident. The federal system (BPA) firm peak load is adjusted to reflect a federal coincident peak among its many utility customers.

Federal System Transmission Losses

Federal System (BPA) transmission losses for both firm loads and contractual obligations are embedded in federal load. These losses represent the difference between energy generated by the federal system (or delivered to a system interchange point) and the amount of energy sold to customers. System transmission losses are calculated by BPA for firm loads utilizing the federal transmission system.

Planning Margin

In the derivation of regional requirements, a planning margin has been added to the load. This regional planning margin is equal to 12 percent of the total peak load for the first year of the planning horizon, increasing one percent per year to 20 percent and remaining at 20 percent thereafter. They are intended to cover, for planning purposes, operating reserves and all elements of uncertainty not specifically accounted for in determining loads and resources. These include forced-outage reserves, unanticipated load growth, temperature variations, hydro maintenance and project construction delays. An increasing reserve requirement reflects greater uncertainty about load levels and of achieving construction schedules in the future.

Demand-Side Management Programs

Savings from demand-side management efforts are reported in *Table 6b: Demand Side Management Programs*. These estimates are the savings for the ten year study period and include expected future energy savings from existing and new programs in the areas of energy efficiency, distribution efficiency, some market transformation, fuel conversion, fuel switching, energy storage and other efforts that reduce the demand for electricity. These estimates reflect savings from programs that utilities fund directly, or through a third-party, such as the Northwest Energy Efficiency Alliance and Energy Trust of Oregon.

Demand response activity is reported separately in *Table 6b*. The total load reduction reported is the cumulative sum of different utilities' agreements with their customers. Each program has its own characteristics and limitations.

Generating Resources

This report considers existing resources, committed new supply (including resources under construction), as well as planned resources. For the assessment of need only the existing and committed resources are reflected in the regional tabulations. In addition, only those generating resources (or shares) that are firmly committed to meeting Northwest loads are included in the regional analysis.

Hydro

Major hydro resource capabilities are estimated from a regional analysis using a computer model that simulates reservoir operation of past hydrologic conditions. The historical stream flow record used covers the 80-year period from August 1929 through July 2008.

Energy

The firm energy capability of hydro plants is the amount of energy produced during the operating year with the lowest 12-month average generation. The lowest generation occurred in 1936-37 given today's river operating criteria. The firm energy capability is the average of 12 months, August 1936 to July 1937. Generation for projects that are influenced by downstream reservoirs reflects the reduction due to encroachment.

Peak Capability

For this report the peak capability of the hydro system represents the maximum hourly generation available to meet peak demand during the period of heavy load.

The peaking capability of the hydro system maximizes available energy and capacity associated with the monthly distribution of streamflow. The peaking capability is the hydro system's ability to continuously produce power for a specific time period by utilizing the limited water supply while meeting power and non-power requirements, scheduled maintenance, and operating reserves (including wind reserves).

Computer models are used to estimate the operational hydro peaking capability of the major projects, based on their monthly average energy for 70 or 80 water conditions depending on the source of information. The peaking capability used for this report is the 8^{th} percentile of the resulting hourly peak capabilities for January and August to indicate winter and summer peak capability respectively. These models shape the monthly hydro energy to maximize generation in the heavy load hours.

Columbia River Treaty

Since 1961 the United States has had a treaty with Canada that outlines the operation of U.S. and Canadian storage projects to increase the total combined generation. Hydropower generation in this analysis reflects the firm power generated by coordinating operation of three Canadian reservoirs, Duncan, Arrow and Mica with the Libby reservoir and other power facilities in the region. Canada's share of the coordinated operation benefits is called Canadian Entitlement. BPA and each of the non-Federal mid-Columbia projects owners are obligated to return their share of the downstream power benefits owed to Canada. The delivery of the Entitlement is reflected in this analysis.

Downstream Fish Migration

Another requirement incorporated in the computer simulations is modified river operations to provide for the downstream migration of anadromous fish. These modifications include adhering to specific flow limits at some projects, spilling water at several projects, and augmenting flows in the spring and summer on the Columbia, Snake and Kootenai rivers. Specific requirements are defined by various federal, regional and state mandates, such as project licenses, biological opinions and state regulations.

Thermal and Other Renewable Resources

Thermal resources are reported in a variety of categories. Coal, cogeneration, nuclear, and natural gas projects are each totaled and reported as individual categories.

Renewable resources other than hydropower are categorized as solar, wind and other renewables and are each totaled and reported separately. Other renewables includes energy from biomass, geothermal, municipal solid waste projects and other miscellaneous projects.

All existing generating plants, regardless of size, are included in amounts submitted by each utility that owns or is purchasing the generation. The energy capabilities of plants are computed on annual planning equivalent availability factors submitted by the sponsors of the projects. The factors include allowance for scheduled maintenance (including refueling), forced outages and other expected operating constraints. Some small fossil-fuel plants and combustion turbines are included as peaking resources and their reported energy capabilities are only the amounts necessary for peaking operations. Additional energy potentially may be available from these peaking resources for emergencies but is not included in the regional load/resource balance.

New and Future Resources

The latest activity with new and future resource developments, including expected savings from demand-side management are tabulated in this report. These resources are reported as *Recently Acquired, Committed New Supply* and *Planned Resources* to reflect the different stages of development.

Recently Acquired Resources

The *Recently Acquired Resources* reported in Table 5 have been acquired in the past year and are serving Northwest utility loads as of December 31, 2014. They are reflected as part of the regional firm needs assessment.

Committed New Supply

Committed New Supply reported in Table 6a includes those projects under construction or committed resources and supply to meet Northwest load that are not delivering power as of December 31, 2014. In this report, resources being built by utilities or resources where their output is firmly committed to utilities are included in the regional load-resource analysis. Future savings from committed demand-side management programs are reported in Table 6b.

Planned Resources

Planned Resources presented in Table 7 include specific resources and/or blocks of resources identified in utilities' most current integrated resource plans. Projects specifically named in *Planned Resources* are not yet under construction as of December 31, 2014, but a firm commitment to construct or acquire the power has been made. These resources are <u>not</u> part of the regional analysis.

Contracts

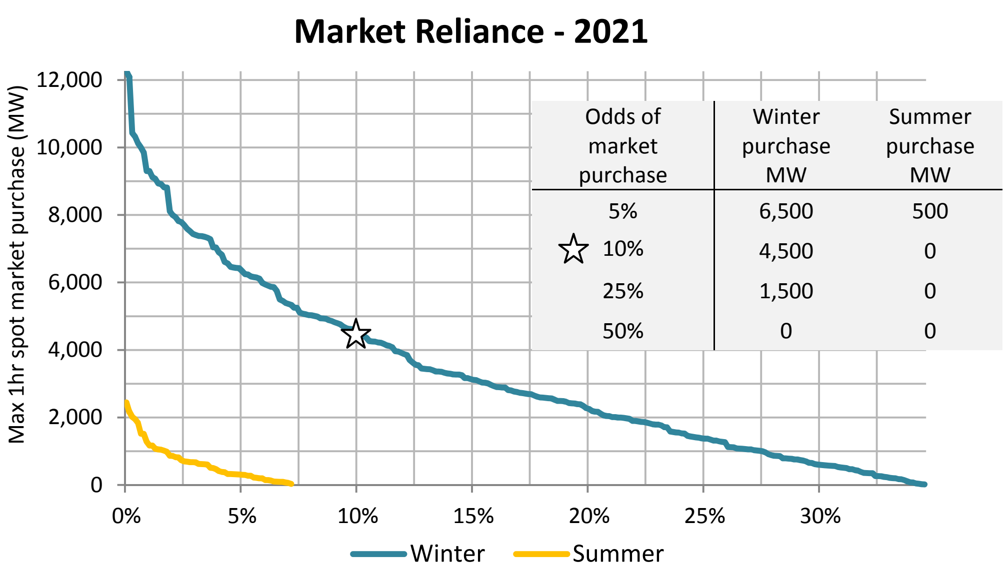
Imports and exports include firm arrangements for interchanges with systems outside the region, as well as with third-party developers/owners within the region. These arrangements comprise firm contracts with utilities to the East, the Pacific Southwest and Canada. Contracts to and from these areas are amounts delivered at the area border and include any transmission losses associated with deliveries.

Market Reliance Analysis

This year's *Forecast* includes an analysis of the Northwest utilities' dependence on the short term/spot market power.[1] The study was conducted using the GENESYS model, which simulates the hourly operation of the Northwest power system given variations in loads due to weather and hydro generation from changing water supply. The assumptions for this analysis were derived from the Northwest Power and Conservation Council's Resource Adequacy Advisory Committee recent studies. Loads from the Council's study were adjusted to reflect the *Forecast's* 2021 regional load. The Boardman power plant was removed for the duration of the study as well.[2]

The analysis reflects all available utility-owned power plants operating to meet the hourly load before spot market purchases were made. The reliance on the spot market was established by tracking the hours and to what extent the power market was used.

Overall the study shows that the Northwest utilities may rely on power markets to maintain system adequacy, especially during winter months. The chart shows the results of the study on a distribution curve. For example, during 10% of the simulations of the year 2021 at least 4,500 MW of spot market power was purchased for one hour or more during the winter.[3]



[1] Market includes northwest Independent Power Producers and out-of-region imports.
[2] Note that Boardman is schedule to retire at the end of 2020.
[3] Winter defined as Dec – Jan; summer defined as Jun – Aug.

Table 9: Utilities included in the Northwest Regional Forecast

Albion, City of
Alder Mutual
Ashland, City of
Asotin County PUD #1
Avista Corp.
Bandon, City of
Benton PUD
Benton REA
Big Bend Electric Co-op
Blachly-Lane Electric Cooperative
Blaine, City of
Bonners Ferry, City of
Bonneville Power Administration
Burley, City of
Canby Utility
Cascade Locks, City of
Central Electric
Central Lincoln PUD
Centralia, City of
Chelan County PUD
Cheney, City of
Chewelah, City of
City of Port Angeles
Clallam County PUD #1
Clark Public Utilities
Clatskanie PUD
Clearwater Power Company
Columbia Basin Elec. Co-op
Columbia Power Co-op
Columbia REA
Columbia River PUD
Consolidated Irrigation Dist. #19
Consumers Power Inc.
Coos-Curry Electric Cooperative
Coulee Dam, City of
Cowlitz County PUD
Declo, City of
Douglas County PUD
Douglas Electric Cooperative
Drain, City of
East End Mutual Electric
Eatonville, City of
Ellensburg, City of
Elmhurst Mutual P & L
Emerald PUD
Energy Northwest
Eugene Water & Electric Board
Fall River Rural Electric Cooperative
Farmers Electric Co-op
Ferry County PUD #1
Fircrest, Town of
Flathead Electric Cooperative
Forest Grove Light & Power
Franklin County PUD
Glacier Electric
Grant County PUD
Grays Harbor PUD
Harney Electric
Hermiston, City of
Heyburn, City of
Hood River Electric
Idaho County L & P
Idaho Falls Power
Idaho Power
Inland Power & Light
Kittitas County PUD
Klickitat County PUD
Kootenai Electric Co-op
Lakeview L & P (WA)
Lane Electric Cooperative
Lewis County PUD
Lincoln Electric Cooperative
Lost River Electric Cooperative
Lower Valley Energy
Mason County PUD #1
Mason County PUD #3
McCleary, City of
McMinnville Water & Light
Midstate Electric Co-op
Milton, Town of
Milton-Freewater, City of
Minidoka, City of
Missoula Electric Co-op
Modern Electric Co-op
Monmouth, City of
Nespelem Valley Elec.Co-op
Northern Lights Inc.
Northern Wasco Co. PUD
NorthWestern Energy
Ohop Mutual Light Company
Okanogan Co. Electric Cooperative
Okanogan County PUD #1
Orcas Power & Light
Oregon Trail Co-op
Pacific County PUD #2
PacifiCorp
Parkland Light & Water
Pend Oreille County PUD
Peninsula Light Company
Plummer, City of
PNGC Power
Port of Seattle – SEATAC
Portland General Electric
Puget Sound Energy
Raft River Rural Electric
Ravalli Co. Electric Co-op
Richland, City of
Riverside Electric Co-op
Rupert, City of
Salem Electric Co-op
Salmon River Electric Cooperative
Seattle City Light
Skamania County PUD
Snohomish County PUD
Soda Springs, City of
Southside Electric Lines
Springfield Utility Board
Steilacoom, Town of
Sumas, City of
Surprise Valley Elec. Co-op
Tacoma Power
Tanner Electric Co-op
Tillamook PUD
Troy, City of
Umatilla Electric Cooperative
Umpqua Indian Utility Co-op
United Electric Cooperative
US Corps of Engineers
US Bureau of Reclamation
Vera Water & Power
Vigilante Electric Co-op
Wahkiakum County PUD #1
Wasco Electric Co-op
Weiser, City of
Wells Rural Electric Co.
West Oregon Electric Cooperative
Whatcom County PUD
Yakama Power

Definitions

Annual Energy

Energy value in megawatts that represents the average of monthly values in a given year.

Average Megawatts

(MWa) Unit of energy for either load or generation that is the ratio of energy (in megawatt-hours) expected to be consumed or generated during a period of time to the number of hours in the period.

Biomass

Any organic matter which is available on a renewable basis, including forest residues, agricultural crops and waste, wood and wood wastes, animal wastes, livestock operation residue, aquatic plants, and municipal wastes.

Canadian Entitlement

Canada is entitled to one-half the downstream power benefits resulting from Canadian storage as defined by the Columbia River Treaty. Canadian entitlement returns estimated by Bonneville Power Administration.

Coal

This category of generating resources includes the region's coal-fired plants.

Cogeneration

Cogeneration is the technology of producing electric energy and other forms of useful energy (thermal or mechanical) for industrial and commercial heating or cooling purposes through sequential use of an energy source.

Combustion Turbines

These are plants with combined-cycle or simple-cycle natural gas-fired combustion turbine technology for producing electricity.

Committed Resources

This includes under construction projects and long-term power supply agreements that are committed but not yet producing power to meet Northwest load at the time of publication. This generation is included in the resources for calculating the regional load/resource balance.

Conservation

Any reduction in electrical power consumption as a result of increases in the efficiency of energy use, production, or distribution. For the purposes of this report used synonymously with energy efficiency.

Demand Response

Control of load through customer/utility agreements that result in a temporary change in consumers' use of electricity in times of system stress.

Demand-side Management

Peak and energy savings from conservation/energy efficiency measures, distribution efficiency, market transformation, demand response, fuel conversion, fuel switching, energy storage and other efforts that that serve to reduce electricity demand.

Dispatchable Resource

A term referring to controllable generating resources that are able to be dispatched for a specific time and need.

Distribution Efficiency

Infrastructure upgrades to utilities' transmission and distribution systems that save energy by minimizing losses.

Encroachment

A term used to describe a situation where the operation of a hydroelectric project causes an increase in the level of the tailwater of the project that is directly upstream.

Energy Efficiency

Any reduction in electrical power consumption as a result of increases in the efficiency of energy use, production, or distribution. For the purposes of this report used synonymously with conservation.

Energy Load

The demand for power averaged over a specified period of time.

Energy Storage

Technologies for storing energy in a form that is convenient for use at a later time when a specific energy demand is greater.

Exports

Firm interchange arrangements where power flows from regional utilities to utilities outside the region or to non-specific, third-party purchasers within the region.

Federal System (BPA)

The federal system is a combination of BPA's customer loads and contractual obligations, and resources from which BPA acquires the power it sells. The resources include plants operated by the U.S. Army Corps of Engineers (COE), U.S. Bureau of Reclamation (USBR) and Energy Northwest. BPA markets the thermal generation from Columbia Generating Station, operated by Energy Northwest.

Federal Columbia River Power System (FCRPS)

Thirty federal hydroelectric projects constructed and operated by the Corps of Engineers and the Bureau of Reclamation, and the Bonneville Power Administration transmission facilities.

Firm Energy

Electric energy intended to have assured availability to customers over a defined period.

Firm Load

The sum of the estimated firm loads of private utility and public agency systems, federal agencies and BPA industrial customers.

Firm Losses

Losses incurred on the transmission system of the Northwest region.

Fuel Conversion

Consumers’ efforts to make a permanent change from electricity to natural-gas or other fuel source to meet a specific energy need, such as heating.

Fuel Switching

Consumers’ efforts to make a temporary change from electricity to another fuel source to meet a specific energy need.

Historical Streamflow Record

A database of unregulated streamflows for 80 years (July 1928 to June 2008). Data is modified to take into account adjustments due to irrigation depletions, evaporations, etc. for the particular operating year being studied.

Hydro Maintenance

The amount of energy lost due to the estimated maintenance required during the critical period. Peak hydro maintenance is included in the peak planning margin calculations.

Hydro Regulation

A study that utilizes a computer model to simulate the operation of the Pacific Northwest hydroelectric power system using the historical streamflows, monthly loads, thermal and other non-hydro resources, and other hydroelectric plant data for each project.

Imports

Firm interchange arrangements where power flows to regional utilities from utilities outside the region or third-party developer/owners of generation within the region.

Independent Power Producers (IPPs)

Non-utility entities owning generation that may be contracted (fully or partially) to meet regional load.

Intermittent Resource (a.k.a. Variable Energy Resource)

An electric generating source with output controlled by the natural variability of the energy resource rather than dispatched based on system requirements. Intermittent output usually results from the direct, non-stored conversion of naturally occurring energy fluxes such as solar and wind energy.

Investor-Owned Utility (IOU)

A privately owned utility organized under state law as a corporation to provide electric power service and earn a profit for its stockholders.

Market Transformation

A strategic process of intervening in a market to accelerate the adoption of cost-effective energy efficiency.

Megawatt (MW)

A unit of electrical power equal to 1 million watts or 1,000 kilowatts.

Nameplate Capacity

A measure of the approximate generating capability of a project or unit as designated by the manufacturer.

Natural Gas-Fired Resources

This category of resources includes the region's natural gas-fired plants, mostly single-cycle and combined-cycle combustion turbines. It may include projects that are considered cogeneration plants.

Non-Utility Generation

Facilities that generate power whose percent of ownership by a sponsoring utility is 50 percent or less. These include PURPA-qualified facilities (QFs) or non-qualified facilities of independent power producers (IPPs).

Nuclear Resources

The region's only nuclear plant, the Columbia Generating Station, is included in this category.

Operating Year

Twelve-month period beginning on August 1 of any year and ending on July 31 of the following year. For example, operating year 2015 is August 1, 2014 through July 31, 2015.

Other Publics (BPA)

Refers to the smaller, non-generating public utility customers whose load requirements are estimated and served by Bonneville Power Administration.

Peak Load

In this report the peak load is defined as one-hour maximum demand for power.

Planned Resources

Planned resources include generic, as well as specific projects, measures, and transactions that utilities have made some commitment to acquire and are in some stage of state site certification process. However, either not all licenses have been obtained, no commercial operation data has been specified, or the specifics of the transaction have not been finalized.

Planning Margin

A component of regional requirements that is included in the peak needs assessment to account for various planning uncertainties.

Private Utilities

Same as investor-owned utilities.

Publicly-Owned Utilities

One of several types of not-for-profit utilities created by a group of voters and can be a municipal utility, a public utility district, or an electric cooperative.

PURPA

Public Utility Regulatory Policies Act of 1978. The first federal legislation requiring utilities to buy power from qualifying independent power producers.

Renewables - Other

A category of resources that includes projects that produce power from such fuel sources as geothermal, biomass (includes wood, municipal solid-waste facilities), and pilot level projects including tidal and wave energy.

Requirements

For each year, a utility's projected loads, exports, and contracts out. Peak requirements also include the planning margin.

Small Thermal & Miscellaneous Resources

This category of resources includes small thermal generating resources such as diesel generators used to meet peak and/or emergency loads.

Solar Resources

Resources that produce power from solar exposure. This includes utility scale solar photovoltaic systems and other utility scale solar projects. This category does not include customer side distributed solar generation.

Thermal Resources

Resources that burn coal, natural gas, oil, diesel or use nuclear fission to create heat which is converted into electricity.

Variable Energy Resource (a.k.a. Intermittent Resource)

An electric generating source with output controlled by the natural variability of the energy resource rather than dispatched based on system requirements. Intermittent output usually results from the direct, non-stored conversion of naturally occurring energy fluxes such as solar and wind energy.

Wind Resources

This category of resources includes the region’s wind powered projects.

BPA Study

The **2014 Pacific Northwest Loads and Resources Study** *published by the Bonneville Power Administration can be accessed at* *http://www.bpa.gov/power/pgp/whitebook/2014/*.

WHOLESALE MARKET RISK

Contents:

The Pacific Northwest (PNW) has experienced a surplus of energy and capacity since the mid-2000s, and that surplus has made it less expensive for utilities like Puget Sound Energy to meet its load needs by purchasing energy and capacity in the wholesale market rather than building new generating plants. Now that the region is forecast to move from a capacity surplus to a deficit in the next decade, it is time to re-evaluate this strategy. Currently, PSE relies on up to 1,666 MW of wholesale market purchases to meet its winter peak load obligations, but continuing this degree of reliance on wholesale market purchases will expose PSE and its customers to increasing financial and physical supply risks under regional deficit conditions. This appendix explores those risks.

EXECUTIVE SUMMARY

The long-term load/resource studies developed by several of the region's major energy organizations, NPCC, PNUCC and BPA,[1] differ in some details, but all of the forecasts point in the same direction: The Pacific Northwest (PNW) energy and capacity surplus will cross over to deficit at some point in the next decade unless new resources are developed. Based upon current information, and assuming that all independently owned generation located within the PNW will be available to serve PNW peak loads, the region will transition from a winter peak surplus of 1,975 MW in 2016 to a winter peak deficit of 3,110 MW in 2025.[2] Several analyses indicate that under deficit conditions PNW load curtailment events will be much larger than has been typically experienced – averaging 1,950 MW and in excess of 10,000 MW for some hours – and may last much longer.[3]

The current loss of load probability planning standard, which measures the frequency of potential load curtailment events, may not be sufficient to fully assess the risks that the region faces under capacity deficit conditions. As the region approaches resource inadequacy, we must sharpen our pencils and consider the magnitude and duration of potential load curtailments in addition to their frequency. Load curtailments would impose significant costs and inconvenience on PSE's customers; on the other hand, additional resources to improve reliability are also costly.

PSE would be particularly vulnerable to large PNW load curtailments, since it is one of the region's largest purchasers of wholesale power; how such curtailments would ripple through the market is a key concern. Some of PSE's wholesale power supplies originate with other load-serving utilities, and those utilities may need to withhold or withdraw market sales in order to serve their own loads as their own capacity surpluses shrink under deficit conditions, further limiting supplies available to PSE.

1 / The Northwest Power and Conservation Council (NPCC or the Council), the Pacific Northwest Utilities Conference Committee (PNUCC) and the Bonneville Power Administration (BPA).
2 / Based on information provided in PNUCC's 2015 Northwest Region Forecast and BPA's 2014 Pacific Northwest Loads and Resources Study. The cited figures include firm imports from California but do not include other short-term imports that may be available.
3 / Based on the Northwest Power and Conservation Council's draft Pacific Northwest Power Supply Adequacy Assessment for 2020 and 2021 (May 6, 2015).

Certain characteristics of the region's wholesale market transactions also contribute to the risk profile in deficit conditions. Three are particularly important: Many transactions are financially firm but not physically firm. Any wholesale physical power sale is subject to curtailment. And, aside from paying liquidated damages, the non-performing party may have no obligation to replace the physical supply of power to the buyer; the buyer must locate and contract for replacement power.

Those who rely heavily on wholesale market power purchases would be exposed to financial and physical risks that are very high, and potentially even extreme. Prices can rise dramatically in times of scarcity, and in some conditions, there may not physically be enough energy or capacity within the region to meet firm loads.

SUMMARY OF FINDINGS

In prior IRPs, PSE assumed that wholesale market purchases were 100 percent reliable. Although past NPCC adequacy analyses had demonstrated that technically, regional capacity would not be sufficient in all circumstances, the region continued to pass peak load adequacy tests, so refining that assumption was not a high priority. In this IRP, we align our Resource Adequacy Model (RAM) with the regional reliability models to translate the regional load curtailments forecast by the NPCC and BPA models to PSE-level impacts. Once we accomplished this, we applied the same analytical approach to evaluating the capacity contribution of wholesale market purchases that we use for all other resources. Capacity contribution refers to the peak capacity contribution of a resource relative to that of a gas-fired peaking plant (this is also referred to as the incremental capacity equivalent). It is calculated as the change in capacity of a generic natural gas peaking plant that results from adding a different resource with any given energy production characteristics to the system while keeping the target reliability metric constant. Figure G-1, summarizes the findings of this analysis. It shows the peak capacity contribution of wholesale market purchases to PSE's portfolio, starting in 2021.[4]

Figure G-1: Capacity Contribution of Wholesale Market Purchases

	2021	
Maximum Capacity of Market Reliance (MW)	1,666	
Effective Capacity Contribution	1,397	
Reduction in Capacity Contribution with Risk in Market Reliance	269	
Incremental Capacity Equivalence (ICE)	84%	(= 1,397 / 1,666)

4 / Additional details regarding the peak capacity contribution of wholesale market purchases are contained in Appendix N.

REGIONAL RESOURCE BALANCE IS CHANGING

The Origins of the Surplus

One response to the 2000-2001 west coast energy crisis was the development of many new generating plants in California and the Pacific Northwest. By 2005, approximately 3,500 MW of new generating capacity had been added in the PNW, most of it in the form of gas-fired combined-cycle combustion turbine (CCCT) plants. Some were developed by load-serving utilities, others by independent power producers (IPPs) who built “merchant plants” to sell power directly into the region’s short- and long-term wholesale markets.

By the mid-2000s, however, conditions had changed. The rapid utility load growth of the late 1990s had slowed, and natural gas prices were relatively low. This combination of events resulted in large energy and capacity surpluses in the PNW region. For a decade, these surpluses have enabled many utilities, including PSE, to use wholesale market purchases to meet load obligations with a high degree of confidence in the reliability of both physical supply and reasonable prices.

The Origins of the Deficit

Today, a different combination of circumstances is expected to produce a capacity deficit in the region within the next 10 years. Factors include load growth, the increasing need for balancing capacity and generating plant retirements.

- **Load Growth**: The region’s loads – especially peak loads – are slowly growing again after the 2008-2009 recession.
- **Growth in Intermittent Resources**: Renewable wind and solar plants have been the focus of most new construction in the region, primarily due to state-mandated renewable energy portfolio targets. The variability of these intermittent resources has substantially increased the region’s need for balancing capacity.
- **Coal Plant Retirements**: Between 2020 and 2025, the Pacific Northwest will lose 2,045 MW of generating capacity and approximately 1,750 aMW of annual energy production as several coal plants are shut down: Boardman (585 MW capacity) and Centralia Unit 1 (730 MW capacity) in 2020, and Centralia Unit 2 in 2025 (730 MW capacity).

In particular, the region’s ability to reliably meet firm winter season peak loads and operating reserve obligations is a concern even after including imports from California, as will be discussed below.

Several regional entities, including NPCC, the PNUCC and BPA have forecast that the combination of moderate PNW load growth and the loss of over 2,000 MW of coal-fired generation in 2020 and 2025 will result in large future regional winter capacity deficits.

Regional Load/Resource Forecasts

The long-term load/resource studies developed by NPCC, PNUCC and BPA differ in some details, but all of the forecasts point in the same direction: The Pacific Northwest capacity surplus will cross over to deficit at some point in the next decade unless new resources are developed. These studies are summarized below, and copies or web links to the reports are included in Appendix F, Regional Resource Adequacy.

NPCC Regional Adequacy Studies for 2020 and 2021. On May 6, 2015, the NPCC published its draft *Pacific Northwest Power Supply Adequacy Assessment for 2020-21*. These studies focused on the region's ability to meet the peak load planning criteria adopted by the Council, which is a 5 percent Loss of Load Probability (LOLP). These LOLP studies incorporated complex modeling of the region's hydroelectric resources and included IPP plants located in the PNW, potential short-term power imports from California, and demand-side management consistent with the Sixth Power Plan. Rather than producing traditional load/resource tables, the NPCC studies produced a series of regional PNW load curtailment events that occur under different scenarios that model varying levels of hydro and wind generation, regional loads and thermal plant forced outages.

NPCC's 2021 study indicates that in order for the PNW to meet the 5 percent LOLP planning standard, the region would need to add 1,150 MW of new gas-fired generating capacity.

The NPCC analysis assumes the following conditions.

- That approximately 700 MW of "emergency" generating resources could be used (on an annual energy-limited basis) to help meet regional peak loads, including 300 MW of backup diesel generators owned by Portland General Electric (PGE) and 300 MW at the Keys pumped storage plant.
- That the 650 MW Grays Harbor gas-fired CCCT plant located in the Puget Sound area could be fully utilized to meet regional peak load needs. (This is problematic, however, since the plant has neither firm gas pipeline capacity nor backup oil supply.)
- That spot market power amounting to 2,500 MW (for on-peak hours) and 3,000 MW (for off-peak hours) could be imported from California during winter peak conditions.

PNUCC Northwest Regional Forecast for 2016 – 2025. PNUCC's annual *Northwest Regional Forecast of Power Loads and Resources* (the NRF) was published in April 2015. This analysis aggregates data from the region's electric utilities to produce region-wide load/resource projections over a 10-year time frame (net of conservation), with particular focus on annual energy and winter season capacity surpluses and/or deficits. The NRF also provides information on the amount of IPP generation located in the region that *may* be available to serve PNW firm loads. The 2015 NRF covers the period 2016 – 2025.

The results of the 2015 NRF indicate that in 2021 the region is forecasted to be 4,288 MW deficient in meeting its winter peak load obligations. This figure is based upon the utility-owned or controlled resources located within the PNW region that are known to be dedicated to serving firm PNW loads, plus 425 MW of long-term firm purchased power agreement (PPA) imports from California.

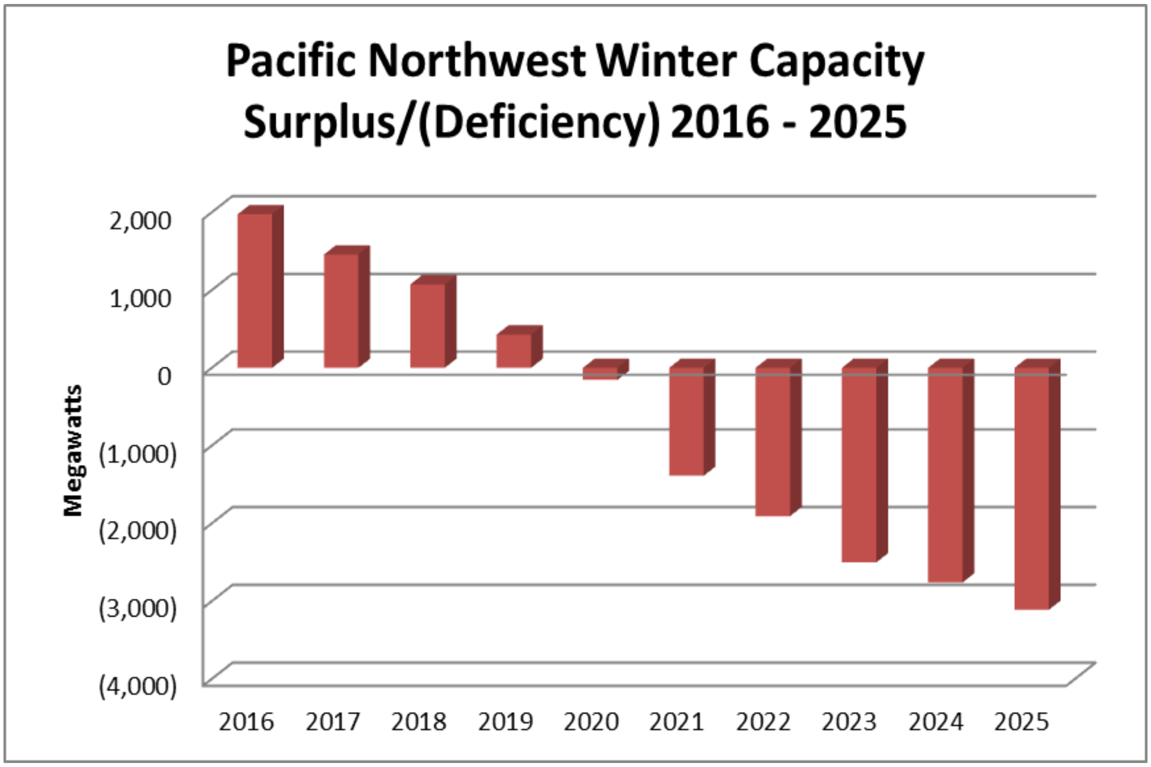
In the PNUCC forecast, if all IPP owned generation located within the region is assumed to be available to serve PNW winter peak loads, the 2021 winter capacity deficit is approximately 1,390 MW.

The NRF forecast does not include any potentially available spot market imports from California.

While looking at surplus/deficit figures for the year 2021 is useful, it is even more important to recognize the long-term trend. Based upon current information, and assuming that all IPP generation will be available to serve PNW peak loads, the region will transition from a 2016 winter season peak load surplus of approximately 1,975 MW to a peak load deficit of 3,110 MW in 2025.

This trend is illustrated in Figure G-2.

Figure G-2: 2015 PNUCC NRF Study,
Pacific Northwest Winter Capacity Surplus/Deficiency, 2016-2025



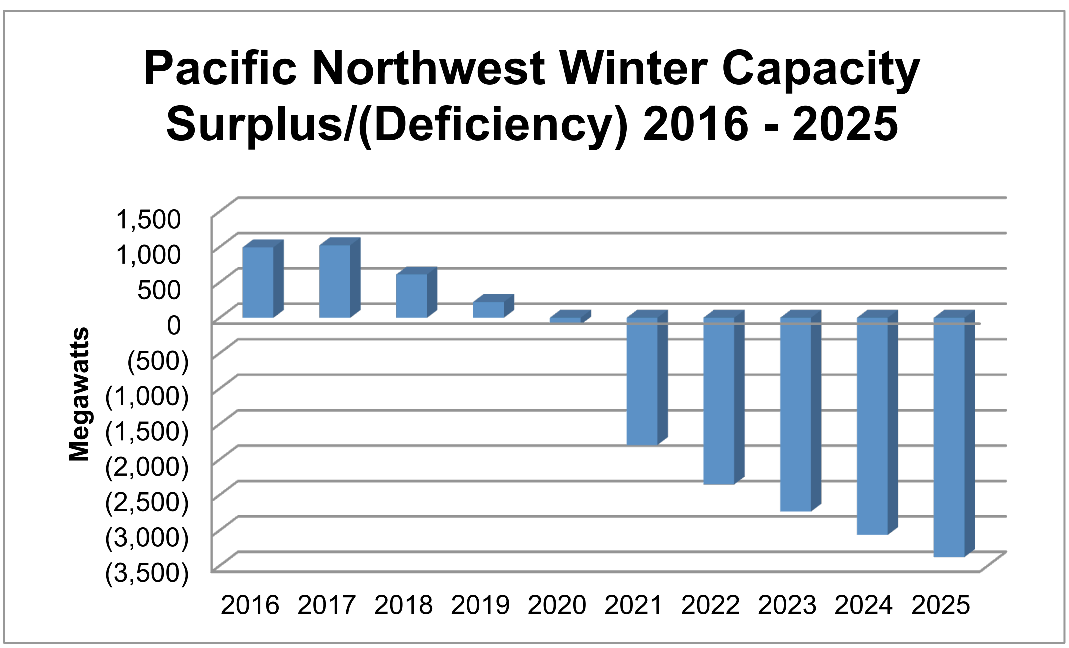
BPA Loads and Resources Study for 2016 – 2025. BPA published its *2014 Pacific Northwest Loads and Resources Study* in January 2015. This study provided detailed information on BPA's forecasted loads and resources as well as overall loads and resources for the entire region. The BPA study is similar to the PNUCC study, but there are some differences, in particular in the modeling of the PNW hydroelectric system and the inclusion of non-utility owned generation located in the PNW region.

The BPA study forecasts an overall regional winter 2021 peak load deficiency of 1,793 MW.

This forecast used a 120-hour sustained hydro peaking methodology, and it assumed that all IPP generation located within the PNW is available to serve PNW peak loads. This figure includes 425 MW of long-term firm PPA imports from California, but it does not include any potentially available spot market imports.

Again, the long-term winter capacity trend is perhaps more important than the exact deficit forecasted for 2021. The BPA study forecasts, as does the PNUCC study, that the PNW is expected to experience larger and larger winter capacity deficits over time. This long-term trend is illustrated in Figure G-3.

Figure G-3: 2014 BPA Study,
Pacific Northwest Winter Capacity Surplus/(Deficiency), 2016-2025



Questions Raised by the Regional Forecasts

Do additional metrics need to be considered? The NPCC's study analyzes PNW regional electric reliability from the perspective of the LOLP planning metric developed by the Council and adopted by some utilities – including PSE. This planning standard requires utilities to have sufficient peaking resources available to fully meet their firm peak load and operating reserve obligations in 95 percent of simulated market conditions.

The LOLP metric measures the likelihood of having one or more regional load curtailment events in a sample year, but it provides no information about the frequency of events within a simulation, the magnitude or duration of those events, nor the benefits or costs to customers of electric service reliability. Some analyses suggest that both the length and breadth of potential outages could increase significantly under regional capacity deficit conditions.

Several PNW utilities and NPCC staff have expressed interest in evaluating and potentially adopting additional metrics to provide regional resource planning stakeholders with a more complete picture of the region's ability to reliably meet peak load and reserve obligations.

- The Expected Unserved Energy (EUE) metric is a quantitative measure of the *magnitude* of the load curtailments.
- The Loss of Load Expectation (LOLE) metric, also called the Loss of Load Hours (LOLH), provides information about the *duration* of the curtailment events.

With this IRP, PSE is shifting from LOLP to EUE as the primary reliability metric for computing its capacity planning margin, since the EUE metric can be used to determine the value of lost loads (VOLL) for the PSE system. This information, in turn, is utilized to identify the economically optimal point where the marginal costs of adding new generating capacity to increase reliability to customers is equal to the marginal benefit created by avoiding supply-driven customer outages.[5]

5 / A complete discussion of VOLL and the associated benefit/cost analysis for increasing customer reliability is included in Appendix N.

LARGER CURTAILMENTS. The EUE metric and the PNW load curtailment volumes from the Council's 2020-21 resource assessment studies are of particular concern to PSE. Several of the curtailment events from the Council's LOLP model are extremely large – in excess of 10,000 MW for some hours – and the average hourly curtailment value in simulations where there is an outage is approximately 1,950 MW. Since PSE is a large purchaser of wholesale market capacity in the winter months (up to 1,666 MW in 2021, with an average peak deficiency of approximately 1,600 MW), it is possible that under some conditions PSE may not physically be able to purchase enough capacity to meet its peak load and operating reserve obligations.

Are energy and capacity imports from California a solution?

The high-voltage AC and DC interties that connect the Pacific Northwest with California were designed to facilitate large transfers of energy and capacity between the two regions. Imports and exports on these interties allow load-serving utilities to take advantage of seasonal load variations, since California peaks in the summer and the Pacific Northwest peaks in the winter.

How much power from California will be available to import for meeting winter peak loads in the future? This is a topic of great interest to the region's resource planners. Determining the amount of power that can reliably be imported from California under winter peak conditions is a complex exercise that involves modeling all of the loads and resources within the Western Electricity Coordinating Council (WECC) and all of the associated transmission lines' transfer path ratings. Recent BPA studies that have been vetted by several regional stakeholders (including the NPCC's Resource Adequacy Advisory Committee) have determined that up to 3,400 MW of energy and capacity could be imported from California under winter peaking conditions during on-peak hours.

However, currently only 425 MW of imports from California are contracted under long-term firm PPAs for the on-peak hours of the winter of 2020-2021. Of that amount, 300 MW is associated with PSE's power exchange agreement with PG&E (Pacific Gas & Electric). The remaining 2,975 MW of south-to-north intertie capability could be used to import spot market power purchases from California.

Curtailment Risks. The potential for forced outages and/or derates on the transmission interties to California is an area of concern for both the PNW region and PSE. Under the conditions discussed above, both the long-term firm imports (425 MW) and the spot market purchases (up to 2,975 MW) would be subject to curtailment.

- According to the regional load/resource forecasts described above, the region will be relying on approximately 1,400 MW to 3,000 MW of California spot market purchases to meet peak loads and operating reserve obligations for the winter of 2020-2021. Should the California interties go out of service during a winter peaking event, the region as a whole could face an immediate, large load curtailment event, since it may not have enough internal generating capacity to meet its firm peak loads.
- For PSE, a forced outage or derate on the California interties could mean losing up to 300 MW of PG&E exchange capacity plus any spot market purchases PSE might be making from California suppliers.

PSE'S MARKET RELIANCE

PSE currently relies on approximately 1,666 MW of wholesale market purchases to meet its firm peak load obligations in the winter season. While all of the region's investor-owned utilities (IOUs) utilize some level of market purchases to meet energy and/or capacity needs, PSE's degree of reliance on the wholesale market to meet peak loads is the largest. Figure G-4 compares the amount of wholesale market purchases that five PNW IOUs planned to use to meet forecasted 2021 peak loads (including reserve margins), according to their 2013 IRPs.

Figure G-4: Forecasted 2021 Seasonal Peak Wholesale Market Purchases by PNW Investor-owned Utilities

Investor-owned Utility	Wholesale Purchases to Meet 2021 Seasonal Peak Load (MW)
Puget	1,666
Avista	0 - 240
Idaho Power	500
PacifiCorp	1,347
Portland General Electric	789

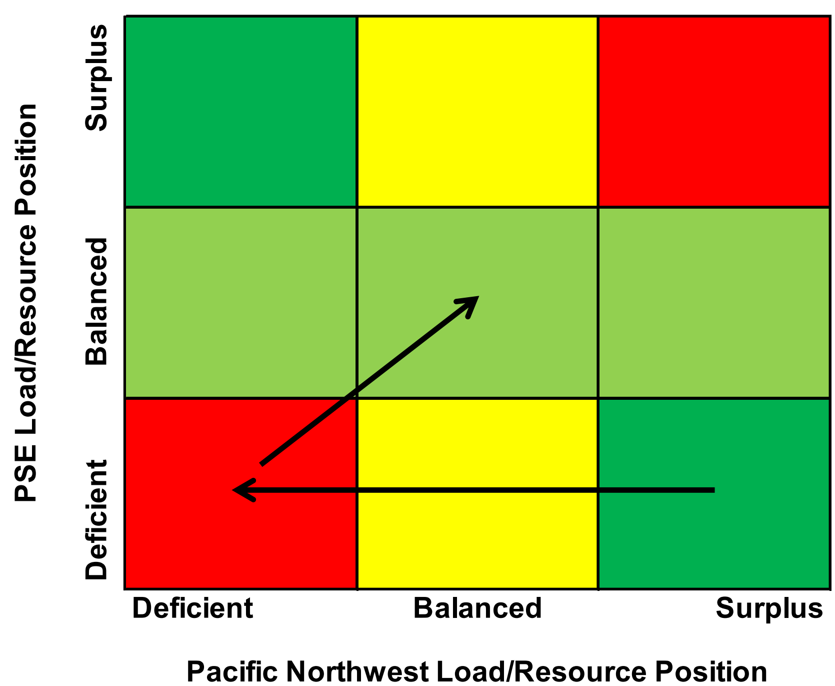
NOTES
1 Avista's loss of load analysis indicated that Avista could rely upon up to 240 MW of wholesale market purchases during some extreme peaking events.
2 PGE indicated that they intend to limit the amount of required winter peak spot purchases in 2021 to only 200 MW.
3 The PacifiCorp data includes both the PacifiCorp East and PacifiCorp West systems.
4 PSE, Portland General Electric, and Avista are winter peaking utilities while PacifiCorp and Idaho Power are summer peaking utilities.

Time to Re-evaluate Strategy

Since the early 2000s, when the regional surplus of energy and capacity began, PSE's strategy has been to position itself as "a buyer in a buyer's market." Instead of constructing new generating plants to meet load growth and replace the loss of long-term legacy PPAs, the company pursued an aggressive program of purchasing relatively lower cost energy and capacity in the wholesale marketplace. Again taking advantage of this position, the company acquired two gas-fired CCCT plants from their original owners at significant discounts from their original construction costs (Goldendale and Mint Farm).

This strategy has been successful at achieving the lowest reasonable cost means of fulfilling customers' energy needs for many years, but now that the marketplace is moving from surplus to deficit, it's time to reevaluate. Being a large buyer in a seller's market is not a favorable risk management strategy. Moving the company into a more neutral risk position is in the best interest of PSE's customers. This concept is illustrated in Figure G-5.

Figure G-5: PSE Winter 2016-2025 Physical Electric Risk Trend – Preferred Scenario



The financial and physical risks of continuing such a high degree of reliance on market purchases are substantial. Several of the California investor-owned utilities that experienced customer blackouts in 2000 and 2001 found themselves exposed in exactly this way when Pacific Northwest and Desert Southwest wholesale power supplies became limited. This combination of circumstances resembles the PNW today in some respects. Factors included 1) long-term load growth, 2) little new power plant development within the state, 3) drought conditions in the Pacific Northwest, and 4) out-of-California utilities needing to conserve scarce power supplies in order to meet their own load-serving obligations.

Growing Risks

The following risks are of greatest concern to PSE.

The Size and Duration of Potential Curtailments. The LOLP studies conducted by NPCC indicated that the region could experience very large load curtailments during the winter of 2020-2021. Under some sets of weather, load and resource availability conditions, they could exceed 10,000 MW. In simulations where outages do occur, the *average* load curtailment amount – approximately 1,950 MW – is significant.

How Curtailments May Be Implemented. If and when regional load curtailments occur, what will they look like? Some of PSE's future wholesale power supplies will likely originate with load-serving utilities in the region. As these load-serving utilities move closer to load/resource balance, the power supplies that PSE has relied upon for purchase from these entities may be limited – or no longer available at all – as they strive to meet their own load-serving obligations.

Physical Supply Availability. Under the conditions in the regional forecasts described earlier, there may not physically be enough energy and capacity available within the PNW (including from spot market imports from California) to meet all of the region's firm loads. So, one or more PNW load-serving entities would be forced to curtail service to its customers. Since PSE is the largest purchaser of winter capacity in the region, PSE's customers would be especially exposed during regional curtailment events, because large portions of the energy and capacity that PSE was counting on to purchase would simply not be available.

Mechanisms for Reducing Risk

Acquiring new sources of generation or building new generation are two mechanisms for reducing exposure to the financial and physical risks of the wholesale market. They have very different impacts on regional conditions.

If PSE were to acquire currently existing sources of generation, it would act as a hedge against the uncertainties and volatility of the wholesale power markets. It would also help PSE reduce its dependence on entities that may or may not have surplus power available to meet the needs of PSE's customers. However, acquiring an existing resource located in the region would not change the region's overall surplus/deficit picture.

Building new generation, on the other hand, would add new incremental supply to the PNW region, which in turn would reduce PSE's wholesale market physical and financial supply risk.

HOW THE PACIFIC NORTHWEST POWER MARKETS WORK

To understand the physical and financial risks that will confront load-serving utilities as energy and capacity supplies grow tighter, it is helpful to understand how the region's wholesale power market is structured and the rules that govern purchase and sale transactions. These are described below. Three conditions are particularly important:

- Many transactions are financially firm but not physically firm.
- Any sale is subject to curtailment.
- And, aside from paying liquidated damages, the non-performing party may have no obligation to replace the physical supply of power to the buyer; the buyer must locate and contract for replacement power.

General Market Structure

Most wholesale power transactions that take place in the WECC are bilateral transactions.[6] The seller and purchaser (sometimes aided by a broker) negotiate the terms and conditions of each individual transaction. No central market entity establishes a price that applies to all transactions. For the same power product and delivery period, the price and terms established for a transaction between counterparties A and B has no direct impact on a transaction negotiated between counterparties C and D. For each transaction, participants are free to negotiate power delivery durations as short as 15 minutes or as long as many years, and purchase/sale commitments can be entered into at almost any time, especially for transactions that are several days in duration or longer.

6 / One area of the WECC has a different market structure. This is the CAISO system that covers a large portion of California. The CAISO uses a centralized bidding process to operate several short-term, single-price auction markets for capacity, energy and ancillary services products. For a specific delivery period, market participants submit the price at which they are willing to purchase or sell a specific quantity of a specific power product. The purchase bids and sales offers are then aggregated, and the CAISO establishes a single clearing price for each product. All buyers and sellers who had their bids/offers accepted receive the identical price for that particular product.

Spot and Forward Markets

"Spot" markets and "forward" markets describe different types of power transactions. The key features of the spot and forward markets of the WECC are described below.

Spot Market. In the WECC wholesale power markets, a spot transaction usually refers to transactions of less than 24 hours in duration that is entered into on a day-ahead or day-of basis. (The FERC has also adopted this definition of a spot transaction for the WECC bilateral markets.)

DAY-AHEAD. The day-ahead (or preschedule) market is designed to handle power deliveries across the next full 24-hour day. For instance, on any given Monday, preschedulers and day-traders will be negotiating power transactions and identifying delivery and receipt information for each of the 24 hours on Tuesday. Transactions can be for an individual hour or for multiple hours. To accommodate weekends, transactions that cover Fridays and Saturdays are usually scheduled on Thursday, and those for Sundays and Mondays are scheduled on Fridays. Holidays are handled in a similar fashion.

SAME-DAY/HOUR-AHEAD. In the same-day market, real-time traders may negotiate and establish transactions for any mutually agreed to volume/price/number of hours. They may also adjust previously negotiated transactions, and these prices may be different than the prices established in the day-ahead market. Price differentials between the day-ahead and same-day markets occur mainly when the real-time condition of the bulk power system differs from what was forecasted on the previous day. Such condition changes include, for instance, a change in weather, a forced outage at a generating plant, higher or lower hydro/wind/solar generation than forecasted, or a transmission line outage.

Forward Power Markets. The WECC's "forward" market allows counterparties to negotiate long-term and/or specialized transactions. The only timing requirement is that they must be established prior to the first day that power is to be delivered under the agreement. Forward transactions often have a first day of delivery that is several months, or even years, following the execution date of the agreement.

Most WECC forward transactions fall into one of five categories: (1) balance of month, (2) monthly, (3) quarterly, (4) one calendar year, or (5) multiple calendar years. The monthly, quarterly and one-year markets tend to be the most active, because counterparties can easily purchase and sell these products in standard 25 MW increments under the Western Systems Power Pool Agreement (WSPP). In contrast, multi-year forward wholesale agreements tend to be "one off" agreements that usually contain customized terms and conditions.

Key Market Characteristics

NO PROOFS REQUIRED. In the WECC power markets, counterparties are not usually required to make any demonstrations regarding either the source or the use of power deliveries at the time they enter into a forward transaction. So, an entity offering to sell power under a forward transaction – say the next calendar month – does not have to "prove" to a potential buyer that it actually has the power it is promising to deliver, and a buyer does not have to prove it can actually accept the power it is purchasing.

This feature allows buyers and sellers to take "unbalanced" or "speculative" positions in the forward markets. The forward position of power marketers and IPPs is difficult to know, since they consider such information proprietary. Load-serving utilities often provide information on their long-term forward positions in their IRPs; however at any given point, their forward positions could differ significantly from what was reported in their last IRP.

SOURCES NEED NOT BE DISCLOSED. Unless the buyer and seller agree in advance to a specific source for the power deliveries, the seller can source power from different entities and/or generators as long as he or she delivers the specified amounts of power at the agreed upon point of delivery. Buyers usually do not learn the exact source of the power being delivered until the completion of the day-ahead preschedule process. For long-term transactions – those spanning monthly/quarterly/annual periods – the source can change many times over the term of the transaction.

The WSPP Agreement

Most of the spot and forward market transactions in the WECC use the Western Systems Power Pool (WSPP) Agreement, a standardized, multi-party contract that allows any member of the WSPP to contract for the purchase or sale of energy and/or capacity with any other member. WSPP members can quickly and easily enter into wholesale power transactions with over 300 individual utilities, power marketers and IPPs without having to separately negotiate all of the associated underlying transaction terms and conditions.

NOT PHYSICALLY FIRM. Wholesale power deliveries from a seller to a purchaser are *not guaranteed to be physically firm* transactions under the standard terms of the WSPP Agreement. Under some conditions specified in the WSPP Agreement, the seller can elect not to physically deliver the contracted energy and/or capacity; likewise, the buyer can elect to not physically receive the contracted energy and/or capacity.

Three Rate Schedules. The current version of the WSPP Agreement offers parties three different rate schedules for the purchase, sale and exchange of wholesale energy and/or capacity. These are described below.

SCHEDULE A

Schedule A transactions are defined as "non-firm" and either the buyer or seller can curtail the contracted delivery amount at any time and for any reason, and neither party is obligated to pay financial damages to the other party. Schedule A transactions are rare.

SCHEDULE B

Schedule B transactions are associated with a specific generating unit or units, so they are often called "unit contingent" transactions. A seller commits to deliver a contracted amount of power to a purchaser from a specified unit(s). However, if the unit(s) cannot produce the contracted amount of power – due to an unscheduled forced outage, for instance – the seller can reduce the sales amount.

SCHEDULE C

The vast majority of WSPP transactions are conducted pursuant to Schedule C. These "firm" transactions are backed by the entire systems of the seller and purchaser. A member's "system" consists of all of the loads and generating units that it owns or controls, and any wholesale purchase or sale contracts that it has in place or may enter into in the future. Sellers are not required to identify the specific source of the power they are contracting to sell until the completion of the day-ahead scheduling process.

Schedule C transactions may be financially firm, but they are not physically firm.

If the seller or purchaser fails to satisfy their obligations (and the failure is not excused under Section C-3.7 of the WSPP Agreement), the other party may be entitled to receive a financial payment called liquidated damages based on the market price of wholesale power at the time the non-performance event(s) occurred.

Curtailments and Schedule C Transactions

- *Any* sale is subject to physical curtailments regardless of the length of the transaction, and curtailments can take place with very little advance notice.
- All sales are treated as equal with regard to curtailments; a one-year transaction could be curtailed ahead of a day-ahead transaction or vice versa.
- The seller chooses which specific transaction or transactions are to be curtailed.

A seller (or buyer) may curtail a Schedule C firm transaction with no financial damages owed to the other party under three conditions:

1. The transaction is curtailed within a "recall period" specified in the agreement between the parties.
2. The transaction is curtailed due to an Uncontrollable Force as defined in Section 10 of the WSPP Agreement. NOTE: Drought is considered an Uncontrollable Force, which is especially relevant in the hydro-dependent PNW.
3. The transaction is curtailed to meet the seller's public utility or statutory obligations to its customers (i.e., reliability of service to native load).

Aside from paying liquidated damages, the non-performing party has no obligation to replace the physical supply of power to the buyer; the buyer must locate and contract for replacement power.

Should there be a physical shortage of power in the market at the time, the buyer shoulders *all* of the physical supply risk.

Price Caps

WSPP Price Caps. WSPP Schedules A, B and C contain rate caps that limit the prices for energy and/or capacity, but they apply to very few WSPP members.[7] The vast majority of members are free to negotiate purchase and sale transactions at any mutually agreeable price.

WECC Price Caps. From time to time, the FERC establishes price caps in the wholesale power markets under its jurisdiction. These are market-wide price caps that apply to all sellers making wholesale power sales in that particular market.

In response to the 2000-2001 West Coast power crisis, the FERC established a WECC-wide price cap of $250 per MWh in June, 2001. The current cap of $1,000 per MWh was established by FERC order in October 2010.[8]

The FERC's price cap has many exceptions.

- The cap applies only to spot market sales in the WECC, which the order defines as "…sales that are 24 hours or less and are entered into the day of or day prior to delivery."
- Sellers can make spot sales at prices higher than the cap if they provide sufficient cost justification to the FERC.
- The order does not address the sale of capacity in either the spot or forward markets.

While the FERC can modify market-wide price caps at any time and on relatively short notice, it is not possible to predict how the agency might react in the case of PNW load curtailments caused by regional energy or capacity shortages.

Price Risk to PSE. Given these conditions, it is possible that PSE could be forced to pay more than $1,000 per MWh in order to meet its load and operating reserve obligations. If the region as a whole experienced a load curtailment event, wholesale prices could experience steep increases as multiple load-serving utilities scramble to locate and purchase scarce amounts of energy and/or capacity to meet their load serving obligations. For example, during a cold weather event in December 2000, day-ahead power prices at the Mid-C reached $3,322 per MWh. In addition, during a summer 2011 capacity shortage in ERCOT, the Electric Reliability Council of Texas, market prices briefly exceeded $3,000 per MWh.

7 / WSPP rate caps apply only to members who: 1) are FERC jurisdictional entities that have not been granted blanket market-based rate authority, or 2) have been restricted by the FERC to selling at cost-based rates in certain market areas where the seller has been found to possess unacceptable levels of horizontal market power. When the FERC does grant blanket market-based rate authority, these individual entity tariffs generally do not include price caps.
8 / FERC Docket No. EL10-56, October 8, 2010

WHOLESALE MARKET RELIABILITY ANALYSIS

To prepare for the coming shift in the region's load/resource balance, PSE has developed a methodology for incorporating the potential impacts of the shift into its IRP planning models. Two main concerns need to be addressed: physical supply risk and financial risk. Our goal is to produce a set of quantifiable metrics that objectively address both types of risk.

This is new territory. There is no established method for incorporating the potential risks associated with region-wide energy and capacity deficits into long-range resource plans, so we began by establishing the following criteria.

- Use existing analytical modeling tools whenever possible, including PSE's LOLP/RAM and financial portfolio cost models.
- Use the results of publically available, region-wide load/resource studies as inputs to PSE's IRP models when possible, primarily the NPCC and BPA LOLP studies for calendar year 2021.
- "Sync up" the inputs and outputs of the NPCC and BPA LOLP model, GENESYS, with PSE's LOLP model, the Resource Adequacy Model (RAM).
- Develop a methodology for translating the regional load curtailments forecast by the NPCC and BPA models into PSE-level impacts. (The result is the Wholesale Purchase Curtailment Model, or WPCM.)
- Introduce regional load curtailments into PSE's RAM model by reducing the amount of wholesale market purchases PSE is able to import into its system.
- Include forced outage events at PSE-owned or jointly owned thermal plants shown in the NPCC and BPA LOLP models in PSE's RAM model in a consistent manner.
- Include the impact of scarcity in the wholesale power price forecasts used in PSE IRP financial models.

The following sections describe how PSE has integrated these physical and financial risks into its IRP modeling process.

Modeling Physical Supply Risk

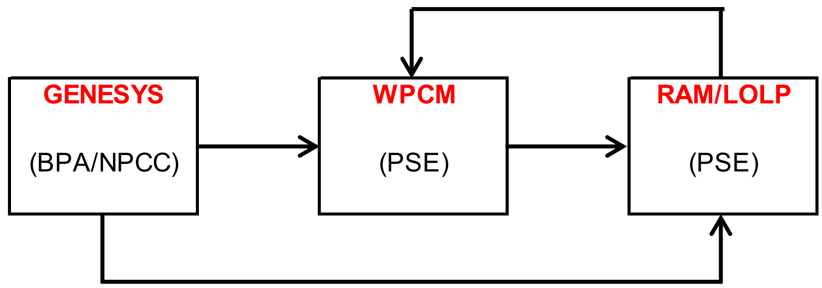
Since PSE is a winter-peaking utility, winter peak load and winter resource capacity are its primary focus with regard to evaluating physical power supply risks. The company's main analytical tool for evaluating the reliability of power supply is its Resource Adequacy Model (RAM). RAM performs a multi-simulation analysis that includes the impacts of variable loads, hydro generation, wind generation, generating plant forced outages (and repair times if plants are on forced outage), and available short-term wholesale market imports to identify the frequency of potential outages under varying conditions, and it calculates reliability metrics including LOLP, EUE, and LOLH/LOLE. From 2009 to 2013, PSE configured its IRP electric resource portfolio to meet a 5 percent LOLP standard; with this IRP, we update that standard and shift from the 5 percent LOLP target to an EUE MWh target that minimizes the total cost of reliability. For a more detailed discussion of this change, see "Updating the Planning Standard" in Chapter 6, Electric Analysis.

Key changes and additions incorporated into PSE's 2015 IRP models are as follows:

- Under some conditions, the amount of wholesale power available for PSE to purchase will be limited to less than its maximum available Mid-C transmission capability of 1,666 MW.
- Limitations on PSE's available supply of wholesale peaking capacity will be tied to the regional load/resource conditions from the NPCC and BPA regional resource adequacy analyses using their GENESYS model.
- Specific hourly reductions will be determined using a newly developed PSE wholesale purchase curtailment model, the WPCM.

In this IRP, PSE is modifying its RAM model to incorporate the most recently available set of PNW regional resource adequacy forecasts for 2021. In particular, PSE is introducing into its RAM model the equivalent of forced outage events for PSE's wholesale market purchases when regional deficit conditions are forecast. Figure G-6 illustrates the individual modeling tools utilized by PSE in the 2015 IRP to evaluate physical supply risk and how the inputs and outputs of these models are linked:

Figure G-6: Market Reliability Analysis Modeling Tools



Each of the modeling steps illustrated in Figure G-6 are discussed in more detail in the following sub-sections.

The GENESYS Model

The GENESYS model was developed by the NPCC and BPA to perform regional-level load and resource studies. GENESYS is a multi-scenario model that incorporates 80 different years of hydro conditions and 77 years of temperature conditions. When combined with thermal plant forced outages, mean time to repair those units and variable wind plant generation, the model determines the PNW's overall hourly capacity surplus or deficiency in each of the 6,160 multi-scenario "simulations." Since the GENESYS model includes all potentially available supplies of energy and capacity that could be utilized to meet PNW firm loads regardless of cost, a regional load curtailment event will occur on any hour that has a capacity deficit.[9]

Since the PNW relies heavily upon hydroelectric generating resources to meet its winter peak load needs, GENESYS incorporates sophisticated modeling logic that attempts to minimize potential load curtailments by shaping the region's hydro resources to the maximum extent possible within a defined set of operational constraints. GENESYS also attempts to maximize the region's purchase of energy and capacity from California (subject to transmission import limits) utilizing both "purchase ahead" (i.e., forward purchases) and spot purchases. GENESYS also incorporates a set of approximately 700 MW of energy-limited "emergency standby resources" that may be called upon to attempt to minimize PNW load curtailment events; these resources include approximately 300 MW of backup diesel generation on PGE's system and 300 MW at the Bureau of Reclamation Keys hydroelectric pumped storage plant.[10]

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9 / Operating reserve obligations are included in the GENESYS model. A PNW load curtailment event will occur if the total amount of all available resources (including imports) is less than the sum of firm loads plus operating reserves.
10 / Pump/generation operations at the Keys hydroelectric pumped storage plant are currently being limited by the Bureau of Reclamation to avoid excessive wear on the units and to meet its irrigation water delivery obligations.

Regional Curtailment Events. PSE utilized two different GENESYS model runs in order to evaluate physical supply risk in the 2015 IRP.[11] The first study (referred to as the base case) evaluated PNW load and resource conditions for calendar year 2021; it was produced by BPA. One of the available outputs from this study is the set of all simulations where there is a PNW-wide load curtailment event (of any magnitude) on any given hour. The GENESYS base case output contained 19,194 hourly load curtailments for the PNW (ranging from 0.2 MW to 10,133 MW) that occurred in 683 of the 6,160 total simulations. This resulted in a region-wide LOLP of approximately 11.1 percent (not including the emergency standby resources).[12]

The second GENESYS model run (referred to as the Grays Harbor case) was also performed by BPA. It was identical to the first study with the exception that the 650 MW Grays Harbor gas-fired CCCT plant was removed from the list of available resources.[13] This second GENESYS model run contained 28,680 hourly load curtailments for the PNW (ranging from 0.2 MW to 10,785 MW) that occurred in 801 of the total 6,160 simulations. This resulted in a PNW region-wide LOLP of approximately 13.0 percent (not including the emergency standby resources).

PSE modified the hourly PNW load curtailments derived by the GENESYS model in both the base case and Grays Harbor case in two ways. In the model runs, several very large PNW curtailment events occurred during off-peak hours (in particular on hours 5, 6, 23 and 24). After consultation with BPA and NPCC staff, PSE performed a re-shaping calculation to smooth out some of the large "spike" events to better reflect actual operating conditions on the PNW hydro system. In addition, PSE limited the maximum hourly PNW load curtailment volume to 6,000 MW to avoid potential spurious computational effects associated with very large curtailment events. This limitation was applied to only 241 of the 19,194 curtailment hours in the base case GENESYS output dataset and 743 of the 28,680 curtailment hours in the Grays Harbor case output dataset.

11 / Support from BPA and NPCC staff was essential for this analysis – PSE is grateful for the assistance they provided and for help from the staff of PNUCC.

12 / The impacts of PGE's backup generation and the Keys pumped storage plant are incorporated into the IRP analysis via the PGE and BPA peaking resources that are included in PSE's Wholesale Purchase Curtailment Model. Including the emergency standby resources in the GENESYS run would result in a PNW LOLP of approximately 8.1 percent.

13 / As has been previously discussed, the Grays Harbor plant's natural gas supply is subject to curtailment during cold weather events and the plant does not have a backup fuel supply.

PSE Wholesale Market Reliability Scenarios. Using the adjusted hourly PNW load curtailments from the two GENESYS studies described above, PSE developed seven separate Wholesale Market Reliability Scenarios in order to evaluate physical supply risks and financial risks. The seven scenarios are as follows:

1. No Wholesale Market Risk: This scenario assumes unlimited wholesale market supplies are available with no risk of interruption under any condition.
2. NPCC 2015 Resource Adequacy Assumptions: This scenario assumes market reliability – or the risk of interruption – consistent with the base assumptions for the resource builds, Southwest energy and capacity imports, and fuel supply availability used in the NPCC's 2015 Resource Adequacy Assessment.
3. NPCC 2015 Assumptions plus 475 MW of additional Imports from California: The NPCC's base analysis assumes 3,400 MW of transmission capacity is available from California, but only 2,925 MW of winter season on-peak resources were included in the NPCC's analysis (2,500 MW of spot market purchases plus 425 MW of long-term contracts). The 3,400 MW figure is based on a BPA transmission study that analyzed historical volumes of power imports from California; this figure represents the 95th percentile level of imports from California during winter season on-peak hours. This scenario adds the spot market import amounts necessary such that total imports from California equal 3,400 MW on all hours.[14]
4. NPCC 2015 Assumptions minus the Grays Harbor Plant: This scenario assumes the 650 MW Grays Harbor is not available to operate during PNW load curtailment events. This gas-fired generating plant appears to rely solely on wholesale market purchases of interruptible fuel supply. It has neither firm pipeline capacity for natural gas fuel supply nor oil backup, which means that under extreme cold weather conditions – when the region is most likely to have a capacity deficit – the plant may not be able to operate until weather conditions improve and wholesale market gas supplies are available again. This assumption is consistent with how PSE's treats its own firm CCCT and CT capacity resources.

14 / Total imports from California during the summer on-peak hours were assumed to be zero in the NPCC's study. This assumption was not changed in any of the Reliability Scenarios.

5. NPCC 2015 assumptions plus PGE's Carty 2 Project: This scenario assumes that Portland General Electric will build the 440 MW generating plant (Carty 2) that it is currently planning to construct, on a timeline roughly consistent with the early retirement of the Boardman coal plant in 2020. While PGE has not announced the specific project technology, this analysis assumes Carty 2 will be a CCCT plant similar to Carty 1. The current status of Carty 2 did not meet the NPCC's criteria for inclusion in the 2015 regional resource adequacy assessment; however, PSE was concerned that leaving this plant out of the regional analysis might overstate our customers' future resource needs.
6. NPCC 2015 assumptions plus PGE Carty 2 plus 475 MW additional CA Imports: This scenario combines assumptions from scenarios 3 and 5 as described above.
7. NPCC 2015 assumptions plus PGE Carty 2 plus 475 MW additional CA Imports minus the Grays Harbor plant: This combines scenarios 3, 4 and 5 as described above.

PSE chose Wholesale Market Reliability Scenario 7 for evaluating resource adequacy impacts in the 2015 IRP.

The PSE Wholesale Purchase Curtailment Model (WPCM)

The Wholesale Purchase Curtailment Model (WPCM) was developed specifically to quantify the impacts of region-wide load curtailment events on PSE. It analyzes PSE's ability to make wholesale market purchases for the amounts of energy and capacity that it needs to meet firm peak load and operating reserve obligations.

As described in the previous sub-section, NPCC and BPA rely upon a multi-scenario modeling tool (the GENESYS model) to provide detailed information regarding the frequency, duration and magnitude of forecasted PNW-wide load curtailment events. However, the GENESYS model is configured to analyze conditions for the region as a whole, so it cannot determine which specific load-serving utility or utilities will bear all, or a portion of, an overall regional load-curtailment event.

PSE developed the WPCM to link PNW-wide load curtailment events, as determined in the GENESYS model, to the specific impacts of those events on PSE. In essence, the WPCM translates, on an hourly basis, a regional load curtailment event (measured in MW) into a reduction in PSE's wholesale market purchases (also measured in MW). In some cases, reductions to PSE's initial desired volume of wholesale market purchases could trigger a PSE load curtailment event in the PSE RAM.

The WPCM Computational Methodology. During a PNW-wide load curtailment event, there is not enough physical power supply available in the region (including available imports from California) for all of the region's load serving utilities to fully meet their firm loads plus operating reserve obligations. The WPCM uses a multi-step approach that mimics how the PNW wholesale markets would likely operate in a physical capacity shortage situation to "allocate" the regional capacity deficiency to the region's individual utilities. These individual capacity shortages are reflected via a reduction in each utility's forecasted level of wholesale market purchases.

The WPCM assumes that under PNW capacity shortage conditions:

1. that all entities that need to purchase capacity in order to meet their own native load-serving obligations will be willing to purchase power up to the same threshold price,
2. that all purchasers in the PNW wholesale marketplace have equal opportunity and ability to locate and purchase needed capacity, and
3. that any load-serving entity that manages to purchase more capacity than it needs to meet its own load-serving obligations will re-sell the surplus capacity to other, still-deficient load serving utilities.

It should be noted that in actual operations, there is no central entity in the PNW charged with allocating scarce supplies of energy and capacity to individual utilities during regional load curtailment events (although Peak Reliability, as the Security Coordinator for the region, would be actively working with the region's utilities to maintain transmission system stability during such events). The PNW wholesale marketplace would, in effect, be the allocating mechanism as multiple parties scramble to enter into purchase and sale transactions under abnormal and probably hectic conditions. It is likely that forward market wholesale transactions would be partially curtailed or fully unwound to the extent allowed under the governing purchase/sale contracts. The WSPP Agreement used for most wholesale power transactions in the PNW markets explicitly allows load-serving utilities to curtail or terminate firm Schedule C sales transactions to meet their own load-serving obligations.

Regional Utility Load Inputs. Because the amounts of capacity that other load-serving entities in the region need to purchase in the wholesale marketplace has a direct impact on the amount of capacity that PSE would be able to purchase, it was necessary to assemble load and resource data for both the region as a whole and for many of its individual utilities, especially those that would be expected to purchase relatively large amounts of energy and capacity during winter peaking events.

For this analysis, PSE chose to use the capacity data contained in BPA's *2014 Pacific Northwest Loads and Resources Study,* because it contained useful differentiation at the regional level and because it treated individual utility data more consistently than other available sources. BPA's study tabulates forecasted loads and resources of non-BPA entities by class (i.e., IOUs, PUDs, municipalities, etc.), and it generally applies the same forecasting assumptions and methodologies to all regional utilities, while the computational methodologies used in individual utility IRPs can vary significantly.

Using the 2020-2021 capacity data contained in the 2014 BPA study and applying some general assumptions, PSE constructed winter 2021 load/resource tables for eight classes of market participants:

1) federal entities
2) cooperatives
3) direct service Industries
4) investor-owned utilities
5) marketers
6) municipalities
7) public utility districts
8) other

From this data, PSE computed the surplus/deficiency positions for each of the eight entity classes under 2021 winter peaking conditions using BPA's 120-hour sustained hydro peaking case.

To create winter peak load/resource tables for the region's investor-owned utilities (several of which are large purchasers of wholesale energy and capacity), PSE assembled load and resource data from 2013 IRPs to create winter 2021 peak load/resource tables for each utility. Forecasted winter 2021 peaking surplus/deficiencies were then determined for each of the following IOUs: PacifiCorp, PGE, Avista, and Idaho Power.

PSE then trued up the 2021 winter peaking surplus/deficiencies between the 2014 BPA study, the IRPs of the above utilities and PSE's own 2015 IRP load/resource data to create a simplified model of the PNW wholesale market for use in the WPCM.[15] Additional information and computational steps were required to incorporate PacifiCorp load/resource information since PacifiCorp East (PACE) is a summer-peaking system and PacifiCorp West (PACW) is a winter-peaking system.[16]

The WPCM model input data also included information regarding the IPP plants located within the region. For these plants, it was assumed that 100 percent of the net winter season capacity, as reported in the 2014 BPA study, would be available to meet PNW loads. Also, since Idaho Power is a summer peaking utility and Idaho's 2013 IRP indicated that it expects to have a moderate winter season capacity surplus for 2021, Idaho's surplus was also assumed to be available to meet PNW winter peak loads.

In addition to deriving base winter 2021 surplus and deficiency values, PSE also computed a set of "sensitivity ratios" for PSE, PGE, BPA, PACW, other utilities, and the combination of the PNW IPPs and Idaho Power. The purpose of the sensitivity ratios is to scale each utility's base surplus/deficiency (which were computed on a single-point deterministic basis) up or down to match the varying hourly PNW load curtailment values from the GENESYS model. The sensitivity ratios are a measure of the relative size of each PNW entity and were computed as follows:

Entity Sensitivity Ratio = (Absolute Value Entity 2021 Peak Load + Entity 2021 Peak Resources) / (Absolute Value PNW Total 2021 Peak Load + PNW Total 2021 Peak Resources).

The sensitivity ratios were computed as a function of both load and resources since the multi-scenario GENESYS model varies both load and generation quantities; therefore, a regional PNW load curtailment event could be the result of either a load-driven event, a generation-driven event, or both.

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15 / PSE performed a series of preliminary sensitivity studies using varying amounts of PSE and other PNW utility winter surpluses and deficiencies to gauge the sensitivity of the WPCM's outcomes to the relative size and number of surplus and deficient utilities in the PNW region. The results of these studies indicated that utilities with small surpluses or deficiencies relative to PSE's average of approximately 1,600 MW, 2021 winter peak deficiency had very little (or no) impact on the level of PSE's computed wholesale purchase curtailments. It was therefore possible to significantly simplify the WPCM by aggregating the smaller utility capacity surpluses and deficits into one proxy "other" utility system.

16 / Deriving winter 2020/21 load and resource information for the PACW system proved challenging given the fact that PacifiCorp overall is a summer peaking system and PacifiCorp's 2013 IRP did not contain separate PACW and PACE load/resource tables under winter peaking conditions. PSE therefore estimated PACW's winter 2021 peak load using a combination of the limited information contained in PacifiCorp's 2013 IRP and publically available historical load data from multiple FERC reports.

The results of the above computations yielded the base set of winter season surpluses and deficiencies and associated sensitivity ratios as shown in Figure G-7 below.

Figure G-7: WCPM Regional Utility Surplus/Deficiencies and Sensitivity Ratios for Winter 2021

PNW Entity	Winter 2021 Peak Load (MW)	Winter 2021 Peak Resources (MW)	Net Peak Sur/(Def) (MW)	Sensitivity Ratio Absolute Value of Peak Load + Peak Resources
PSE	(5,944.1)	4,360.0	(1,584.1)	0.15
PGE	(4,156.0)	3,368.0	(789.0)	0.11
PACW	(4,334.9)	3,159.0	(1,175.9)	0.11
BPA	(10,922.0)	10,125.0	(797.0)	0.30
Other PNW Utilities	(7,746.0)	7,111.0	(635.0)	0.21
PNW IPPs+IPC	(2,939.0)	6,127.0	3,188.0	0.12
PNW IPPs	(265.0)	3,162.0	2,897.0	
Idaho Power	(2,674.0)	2,965.0	291.0	
Total	**(36,042.0)**	**34,250.0**	**(1,793.0)**	**1.00**

NOTE: The PacifiCorp winter season deficiency is for the PACW system only.

Allocation Methodology. For each hour that there is a PNW load curtailment, the WPCM simulates how the five largest purchasers of winter season capacity in the PNW wholesale markets – PSE, PACW, PGE, BPA and all other utilities – would compete to purchase scarce supplies of capacity.

FORWARD MARKET ALLOCATIONS. The model assumes that each of the five large buyers purchases a portion of their base case capacity deficit in the forward wholesale markets. Under most scenarios, each utility is able to purchase their target amount of capacity in the forward markets. This reduces the amount of remaining capacity available for purchase in the spot markets. If the wholesale market does not have enough capacity to satisfy all of the forward purchase targets, those purchases are reduced on a pro-rata basis based upon each utility's initial target purchase amount.

SPOT MARKET ALLOCATIONS. For spot market capacity allocation, each of the five large utility purchasers is assumed to have equal access to the PNW wholesale spot markets (including available imports from California). The spot market capacity allocation *is not* based on a straight pro-rata allocation, because in actual operations, the largest purchaser (which is usually PSE) would not be guaranteed automatic access to a fixed percentage of its capacity need. Instead, all of the large purchasers would be aggressively attempting to locate and purchase scarce capacity from the exact same sources. Under deficit conditions, the largest of the purchasers would tend to experience the biggest MW shortfalls between what they need to buy and what they can actually buy. This situation is particularly true for small to mid-sized regional curtailments where the smaller purchasers may be able to fill 100 percent of their capacity needs but the larger purchasers cannot.

WPCM Outputs. For each simulation and hour in which there is PNW load curtailment event (as determined in the GENESYS model), the WPCM model outputs the following PSE specific information:

- PSE's initial wholesale market purchase amount (in MW), limited only by PSE's overall Mid-C transmission rights.
- The curtailment to PSE's market purchase amount (in MW) due to the PNW regional capacity shortage.
- PSE's final wholesale market purchase amount (in MW) after incorporating PNW regional capacity shortage conditions.

As discussed above, the amount of PSE's wholesale purchase reductions is not a straight pro-rata calculation; rather PSE's percentage reduction in its initial target wholesale purchase amount varies depending upon

1. the magnitude of the PNW regional load curtailment event, and
2. the capacity deficits of PSE and the other large capacity purchasers under each specific PNW load-curtailment event.

Figure G-8 illustrates this point for several different magnitudes of hourly load curtailment events from the same simulation of the base case GENESYS model:

Figure G-8: Hourly Load Curtailment Events from the GENESYS Model

Initial Hourly PSE Wholesale Purchase (MW)	PNW Load Curtailment Amount (MW)	Final Hourly PSE Wholesale Purchase (MW)	PSE Hourly Purchase Reduction (Percent)	PSE Share of PNW Load Curtailment (Percent)
1,584.0	(249.7)	1,334.3	15.8%	100.0%
1,579.0	(801.2)	1,071.0	32.2%	63.4%
1,659.0	(2,730.4)	702.4	57.7%	35.0%
1,634.0	(3,458.4)	561.5	65.6%	31.0%
1,658.0	(5,155.9)	264.2	84.1%	27.0%
1,583.0	(6,000.0)	83.3	94.7%	25.0%

Summary of WPCM Results. Before incorporating wholesale purchase availability risk, PSE's average 2021 wholesale purchase amount was 1,584 MW during the 19,194 hours in the GENESYS model base case where there were PNW load curtailments. After incorporating the WPCM to translate the impacts of PNW-wide load curtailments onto PSE's system, PSE's average wholesale market purchases were reduced to only 857 MW. Incorporating wholesale market availability risk therefore resulted in a 46 percent reduction in the average hourly amount of energy and capacity available for PSE to meet its firm winter peak load and reserve obligations. Furthermore, on some hours, PSE's wholesale purchases were reduced by as much as 99 percent from their original amounts; these large PSE wholesale purchase reductions occur during the very large PNW load curtailment events (i.e., 6,000 MW).

Summary results from the WPCM for each of the seven previously defined Wholesale Market Reliability Scenarios are contained in Figure G-9.

Figure G-9: PSE Wholesale Market Purchases by Scenario

Reliability Scenario	Initial Average PSE Wholesale Purchase (MW)	Final Average PSE Wholesale Purchase (MW)	Average Purchase Reduction (MW)	Average Purchase Reduction (Percent)
1	1,584.1	1,584.1	0.0	0
2	1,584.1	856.6	(727.5)	45.9%
3	1,585.4	902.6	(682.8)	43.1%
4	1,581.0	827.3	(753.8)	47.7%
5	1585.6	873.0	(712.6)	44.9%
6	1586.5	899.9	(686.6)	43.3%
7	1,582.2	867.1	(715.1)	45.2%

Linking the WPCM and RAM Models. PSE's RAM operates much like the GENESYS model, except that it is designed to analyze load/resource conditions for PSE's power system rather than the entire PNW region.[17] Like the GENESYS model, PSE's RAM is a multi-scenario model that varies a set of input parameters across 6,160 individual simulations, and the result of each simulation is PSE's hourly capacity surplus or deficiency. The loss of load probability, expected unserved energy and loss of load hours/expectations for the PSE system is then computed across the 6,160 simulations.

The hourly wholesale market purchases that PSE imports into its system using its long-term Mid-C transmission rights are one of the RAM input variables. The initial set of hourly imports is computed as the difference between PSE's maximum import rights (which total approximately 2,300 MW in 2021) less the amount of transmission capability used to import generation from PSE's Wild Horse wind plant and PSE's contracted shares of the Mid-C hydro plants. To reflect regional deficit conditions, this initial set of PSE hourly wholesale market imports is reduced on the hours when a PNW load curtailment event is identified by the WCPM. The final set of hourly PSE wholesale imports from the WPCM is then used as a data input into the PSE RAM, and PSE's loss of load probability (LOLP), expected unserved energy (EUE), and loss of load expectation (LOLH) are then determined. In this fashion, the LOLP, EUE and LOLH metrics determined in the RAM incorporate PSE's wholesale market reliance risk.

Calculating the Capacity Contribution of Wholesale Market Purchases

With the reliability of wholesale market purchases now reflected in PSE's RAM, we applied the same analytical process to estimate the capacity value of wholesale market purchases that we use for other resources, including existing and new wind resources and Colstrip. That is, just as PSE cannot count on the full nameplate capacity of a wind plant to meet peak capacity needs because the wind doesn't blow all the time, we cannot always count on the full 1,666 MW of wholesale market purchases to meet our peak need, because the wholesale market is not perfectly reliable. To make this assessment of capacity value, we use Incremental Capacity Equivalence (ICE) analysis.[18] The results of this capacity value analysis are summarized in Figure G-10.

17 | PSE's RAM is described in detail in Appendix N.
18 | The ICE analysis for PSE's wholesale market purchases and other resource types are discussed in Appendix N.

Figure G-10: Capacity Value of PSE's Wholesale Market Purchases

	Maximum Capacity	Capacity Needed to Maintain Optional EUE	Incremental Capacity Equivalent
PSE Wholesale Market Purchases (Using Available Mid-C Transmission Rights)	1,666 MW	269 MW	84%

The results shown in Figure G-10 utilize the results of Wholesale Market Reliability Scenario 7, which makes the following adjustments to the May 2015 NPCC regional resource assumptions. We believe it is reasonable to increase potential capacity imports from California up to the full 3,400 MW of available transmission import capability. Likewise, it seems reasonable to assume PGE will follow through with plans to build an additional 440 MW plant by the time Boardman is retired in 2020. Finally, we felt it was appropriate to remove the 650 MW Grays Harbor CCCT plant from the regional adequacy analysis. The plant does not appear to have a verifiable firm fuel supply (PSE purchased the firm pipeline capacity for Grays Harbor from Duke Energy several years ago for our gas utility operations), nor does it have backup fuel supply.

At the regional level, the Resource Adequacy Steering Committee has struggled with how to model the Grays Harbor plant, because removing it completely from the regional adequacy studies might overstate the impact. However, Grays Harbor is most likely to be unable to get gas supply during winter season cold weather events, which is exactly the same time that capacity from the plant is most needed to help meet electric system peak load demands. That leaves us with two imperfect choices: 1) we can either assume a 100 percent reliable fuel supply for Grays Harbor (which may over-state the reliability of the wholesale market), or 2) we can remove it completely from the analysis (which may under-state the reliability of the wholesale market). For the above stated reasons, we chose to remove the plant from the analysis.

Other Modeling Considerations and Uncertainties

PSE plans to continue to refine its wholesale market risk analysis models in a number of areas; six of these are described below. Several of these areas have also been identified by NPCC and PNUCC staff as areas for improvements to the PNW-wide load/resource models.

Market Friction. The various PNW-level load/resource models used by the NPCC, PNUCC and BPA, as well as PSE's own RAM and WPCM models, assume that the wholesale markets always operate in an optimally efficient fashion. However, many real-world uncertainties and behaviors are difficult to incorporate into the models. For instance, during a severe winter cold weather event, the region's load-serving utilities would be expected to be very conservative with regard to meeting their statutory native load obligations. This could lead some utilities to forego making wholesale power sales in advance of the delivery hour, even though, after the fact, some surplus capacity may have been available. In addition, utilities operating energy-limited hydroelectric-based systems may not be willing to sell "surplus" water today if they think they may need that same increment of water at a future point in time to meet their own load-serving obligations. Incorporating this "market friction" impact could therefore result in more frequent and/or severe PNW load-curtailment events than the current set of models indicate.

California Intertie Outages and Derates. The aforementioned regional load/resource models do not fully incorporate the potential for outages and/or derates on the interties that interconnect the PNW with California. Such transmission outages could cause additional PNW load curtailment events (above and beyond what the current set of models indicate). This is an especially important issue for PSE since it relies upon 300 MW of firm imports from California to meet winter peak loads, under a long-term PSE/PG&E Exchange Agreement. PSE's IRP models currently assume that PG&E Exchange deliveries are 100 percent firm, even though in actual operations, the full 300 MW amount is occasionally reduced due to transmission derates.

Balancing Reserves for Intermittent Resources. The BPA and NPCC versions of the GENESYS model used to produce PNW-level load/resource studies include real-time balancing reserves for the wind plants located within the BPA Balancing Authority Area (BAA), but they do not include balancing reserves that must be maintained by other BAAs in the region, including PSE. For instance, under PSE's Open Access Transmission Tariff (OATT) PSE has an obligation to provide real-time capacity reserves for all of our transmission customers in addition to providing these reserves for its own 273 MW Wild Horse wind plant (unless the customer specifically requests to provide their own reserves). By excluding the wind and solar balancing reserves that are required to be maintained by non-BPA entities, the GENESYS model is likely understating the region's overall operating reserve requirement, and in turn may be understating the frequency and magnitude of potential PNW load curtailment events.

Fuel Supplies for Generating Plants. Generating plant fuel supplies are an issue of concern for regional load/resource planners. Since the PNW is a heating-load driven/winter-peaking region, demand for natural gas supplies tends to peak at the same time as the demand for electricity. A shortage of gas supply or limitations on gas pipeline capacity could lead to natural gas deliveries being curtailed to some gas-fired CCCT and CT generating plants. While many PNW gas-fired generating plants have backup fuel supplies (generally oil), at least one major plant – the 650 MW Grays Harbor CCCT plant – does not have a backup fuel supply. As an Independent Power Producer, the status of this plant's fuel supply is first and foremost a contractual issue between the plant's owner (Invenergy) and the entities that are purchasing power from the plant. However, since the NWPP's adequacy studies assume that all PNW IPP generating capacity will be available to meet regional peak loads, the firmness of the plant's fuel supply is a regional-level issue as well.

Syncing Up Thermal Plant Forced Outages. Forced outages at the region's thermal generating plants are a contributing factor to potential PNW load curtailment events. Both the regional GENESYS model and PSE's RAM model incorporate this impact, but the two models determine forced outages events independently of each other. However, if the GENESYS model has a thermal plant outage that occurs at one of PSE's owned (or jointly owned) thermal plants, it should also be included in PSE's RAM model (for the exact same simulation and hour) so that PSE can more accurately "sync up" its hourly system capacity surplus or deficit with PNW regional resource conditions. Limitations on extracting data from the GENESYS model prevented PSE from being able to fully synchronize forced outage events between the two models for this analysis.

Operating Reserves Available from Third Parties. The utilities and generators that are members of the Northwest Power Pool (which includes PSE) operate a reserve-sharing program. Under this program, members pool their individual contingency (i.e., forced outage) reserve obligations such that the amount of reserves each member is required to maintain is lower than it would be in the absence of the program. If an NWPP member has a qualified forced outage event, and if it has used all of the reserves that it is required to maintain under the reserve-sharing program, that member is entitled to request and receive additional amounts of energy and capacity from other members up to the full amount of the outage for up to 60 minutes following the initiation of the outage event. PSE's LOLP model incorporates this reserve-sharing feature. However, should PSE suffer a forced outage when the region is experiencing a load curtailment event, it is unlikely that PSE would be able to access the amount of additional operating reserves it is entitled to receive under the NWPP reserve-sharing program. This potential impact was not included in PSE's 2015 IRP LOLP modeling.

OPERATIONAL FLEXIBILITY

Contents

Operational flexibility discussions have often focused on wind integration due to the historic increases in wind capacity in the Pacific Northwest, however the need for flexibility is actually more complex. Load fluctuations, Balancing Authority obligations to integrate scheduled interchanges and unexpected events like forced outages all place demands on system flexibility. So does the need to maintain contingency reserves to assist other balancing authorities that may have sudden needs for help balancing loads.

Note: *This flexibility analysis originally appeared in PSE's 2013 IRP. Personnel departures prevented the completion of the 2015 analysis at this time, but PSE plans to provide a complete flexibility analysis in our next IRP. The 2013 analysis included only the flexibility benefit of thermal plants; later, the same analysis was used to find the expected annual balancing savings of $99.52 per kilowatt-year for batteries. In addition, two developments related to operational flexibility have taken place since the 2013 IRP. PSE has completed an update on operations and maintenance costs for gas-fired resources, and we are scheduled to join the voluntary, within-hour Energy Imbalance Market (EIM) operated by the California Independent System Operator (CAISO) effective October 1, 2016. Within the EIM, PSE will be able to utilize market resources to fulfill energy flexibility requirements on a 5-minute and 15-minute basis. Both of these developments will be reflected in future flexibility analyses.*

OVERVIEW

This 2013 IRP analysis endeavors to examine the issue of operational flexibility in a holistic manner that takes into account the full range of demands that impact system balancing. It looks at the need for balancing reserve capacity, the supply of this capacity available from PSE resources and the deployment of that capacity each hour to maintain load/resource balance. The process has resulted in better understanding of the operational flexibility needs. It has also established a starting point for better understanding the cost implications associated with maintaining sufficient flexibility in the system, although further work in this area needs to be done.

This appendix is divided into five sections.

System Balancing discusses the role of balancing capacity, the Control Performance Standard 2 (CPS2) metric used to gauge PSE's ability to reliably balance the system and how PSE defines variability and uncertainty as they relate to balancing.

Flexibility Supply and Demand covers how PSE evaluates the availability of balancing capacity from PSE resources in light of the demands placed on the system for that capacity, and discusses how that capacity is procured and deployed.

Modeling Methodology reviews two models used to assess how PSE will meet its balancing obligations in 2018. The first model determines how best to set aside balancing reserves prior to an operating hour; the second simulates deployment of those reserves at 10-minute intervals.

Finally, we present the analysis **Results** and offer a **Conclusion and Next Steps**.

Four 2018 resource scenarios were analyzed. The first used the lowest reasonable cost portfolio identified in the analysis for the 2013 IRP Base Scenario; then, each of the incremental scenarios added one unique gas-fired resource capable of providing balancing services to the portfolio.

While additional work needs to be done, given the assumptions made for this study, the analysis indicates PSE has sufficient capacity and flexibility in the 2013 IRP Base Scenario portfolio to effectively meet its known Balancing Authority demands in 2018 across both hour-ahead and intra-hour time frames. Balancing-related cost savings in the incremental portfolios ranged from $300,000 to $1,000,000 annually depending on the gas-fired resource analyzed, compared to the 2013 IRP Base Scenario portfolio of resources.

SYSTEM BALANCING

The PSE Balancing Authority

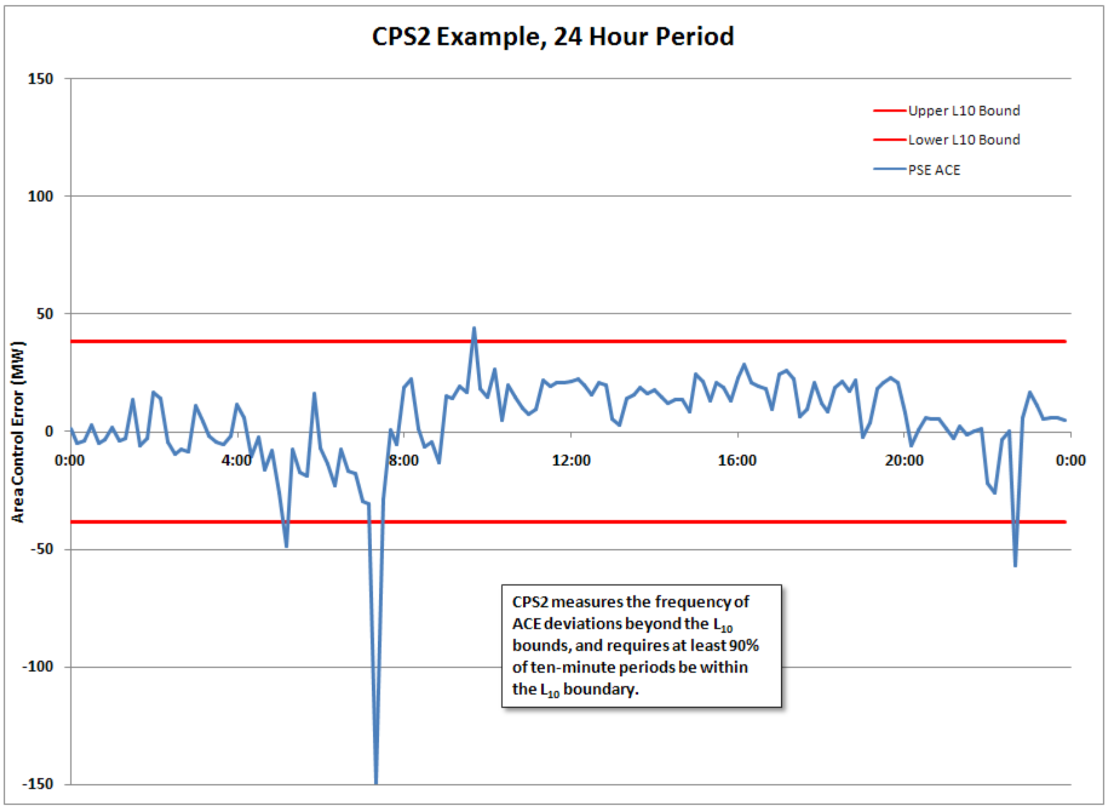
A Balancing Authority (BA) is an entity that manages generation, transmission, and load; it maintains load-interchange-generation balance within a geographic or electrically interconnected Balancing Authority area, and it supports frequency in real time. The responsibility of the PSE Balancing Authority is to maintain frequency on its system and support frequency on the greater interconnection. To accomplish this, the PSE BA must balance load with generation on the system at all times. When load is greater than generation, a negative frequency error occurs. When generation is greater than load, a positive frequency error occurs. Small positive or negative frequency deviations are acceptable and occur commonly during the course of normal operations, but moderate to high deviations require corrective action by the BA. Large frequency deviations can severely damage electrical generating equipment and ultimately result in large-scale cascading power outages. Therefore, the primary responsibility of the BA is to do everything it can to maintain frequency so that load will be served reliably.

The Area Control Error (ACE) metric has been used for many years to track the ability of a BA to meet its reliability obligation. ACE is the instantaneous difference between actual and scheduled interchange, taking into account the effects of frequency. It reflects the balance of generation, load and interchange. Balancing Authority ACE determines how much a BA needs to move its regulating generation units (both manually and automatically) to meet mandatory control performance standard requirements.

By properly managing its ACE, PSE meets several key objectives: it reliably serves its customers, it maintains regulatory compliance, and it minimizes frequency excursions originating within its own BA that could impact other BAs or Transmission Operators (TOP) within the interconnection. PSE's CPS2 metric sets a requirement for how far and often its system can stray from load and generation being in balance. CPS2 measures whether the average ACE stays within a given boundary over a 10-minute period; this is the L10 value. At least 90 percent of the 10-minute periods in each month must be within the +/- L10 boundary to meet the CPS2 requirement. The L10 value is provided to PSE by the North American Electric Reliability Corporation (NERC). The PSE system responds to ACE every four seconds to ensure that PSE's average CPS2 score exceeds the required 90 percent for compliance. CPS2 is a concrete benchmark for assessing system reliability, and it is one of the metrics used to determine the adequacy of PSE's portfolio in this analysis.

Balancing reserves refer to capacity held back on the PSE system to respond to negative and positive frequency errors. These can be incremental (INC) or decremental (DEC). Incremental capacity adds energy to the grid, decremental capacity reduces power to the grid. Contingency reserves are also required in addition to balancing reserves; these are capacity reserved in spinning and non-spinning forms for managing a large negative frequency event such as a sudden loss of generation in PSE's BA or a neighboring BA. Contingency reserves are used for the first hour of the event only.

Figure H-1: Example of Control Performance Standard 2



Impact of Variability and Uncertainty on System Volatility

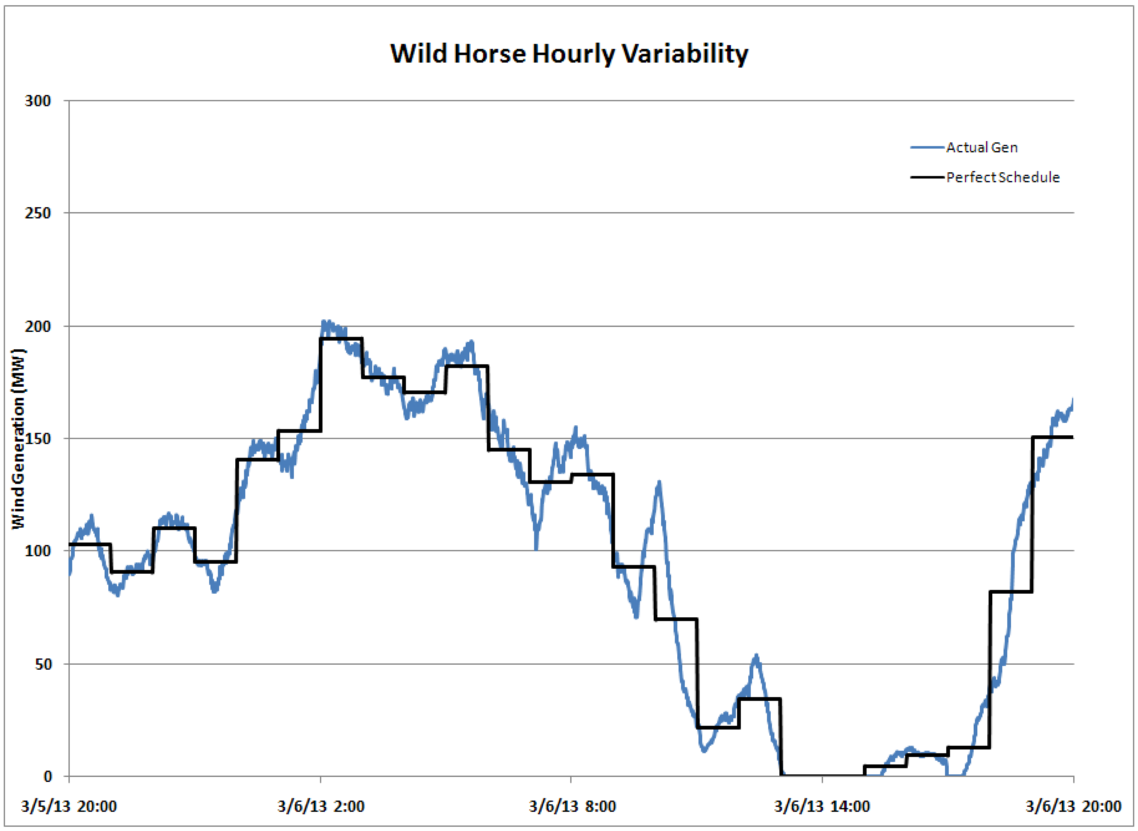
Variability is the moment-to-moment, natural fluctuations in loads and generating resources and is always present on the electric system. Uncertainty is the inability to perfectly predict the hourly values for loads and generating resources. Volatility refers to the collective variability and uncertainty observed system-wide.

Understanding the distinction between variability and uncertainty is essential when discussing ways to manage and potentially reduce volatility across the entire PSE system. Variability is a smaller component of volatility than uncertainty. It is largely uncontrollable, since it is caused by random changes in loads, generating resource power output and fuel availability (such as wind). Uncertainty is the larger component of system volatility, but there are tools that can be used to reduce this uncertainty. For example, improvements in load and wind forecasting can increase the accuracy of load and wind generation schedules, reducing the need to provide balancing energy. Also, shortening scheduling windows can reduce the impact of both variability and uncertainty on system volatility. Currently the PSE BA must manage system volatility over 60-minute scheduling periods. If shorter scheduling windows are ultimately implemented in the region, it would reduce the magnitude of scheduling errors and the length of time PSE has to manage system volatility with generating resources internal to its system. Shorter scheduling windows would also allow PSE to use market transactions more frequently as a tool to address deviations in system conditions.

2015 IRP Update: *To help address system flexibility needs, PSE is scheduled to join the voluntary, within-hour Energy Imbalance Market (EIM) operated by the California Independent System Operator (CAISO) effective October 1, 2016. Within the EIM, PSE will be able utilize market resources to fulfill energy flexibility requirements on a 5-minute and 15-minute basis. This will be reflected in future flexibility analyses.*

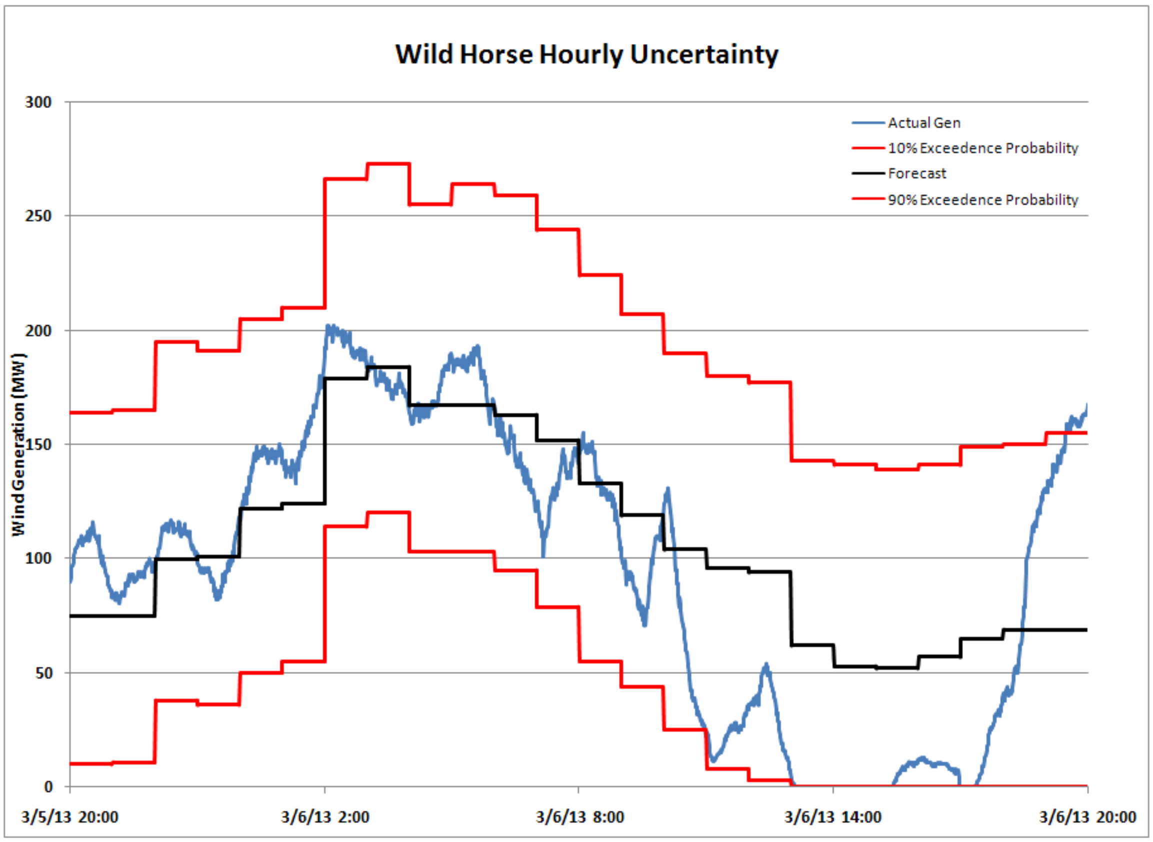
Figures H-2 through H-4 use a 24-hour period at the Wild Horse Wind Facility to illustrate examples of variability, uncertainty and volatility. In Figure H-2, the variability of Wild Horse is shown as the moment-to-moment generation relative to a perfect hourly schedule (a perfect hourly schedule equals the hourly average actual generation). It shows that even equipped with a perfect schedule, PSE must still manage fluctuations in wind generation within the hour, along with other deviations on the system.

Figure H-2: Hourly Variability in Wind Generation



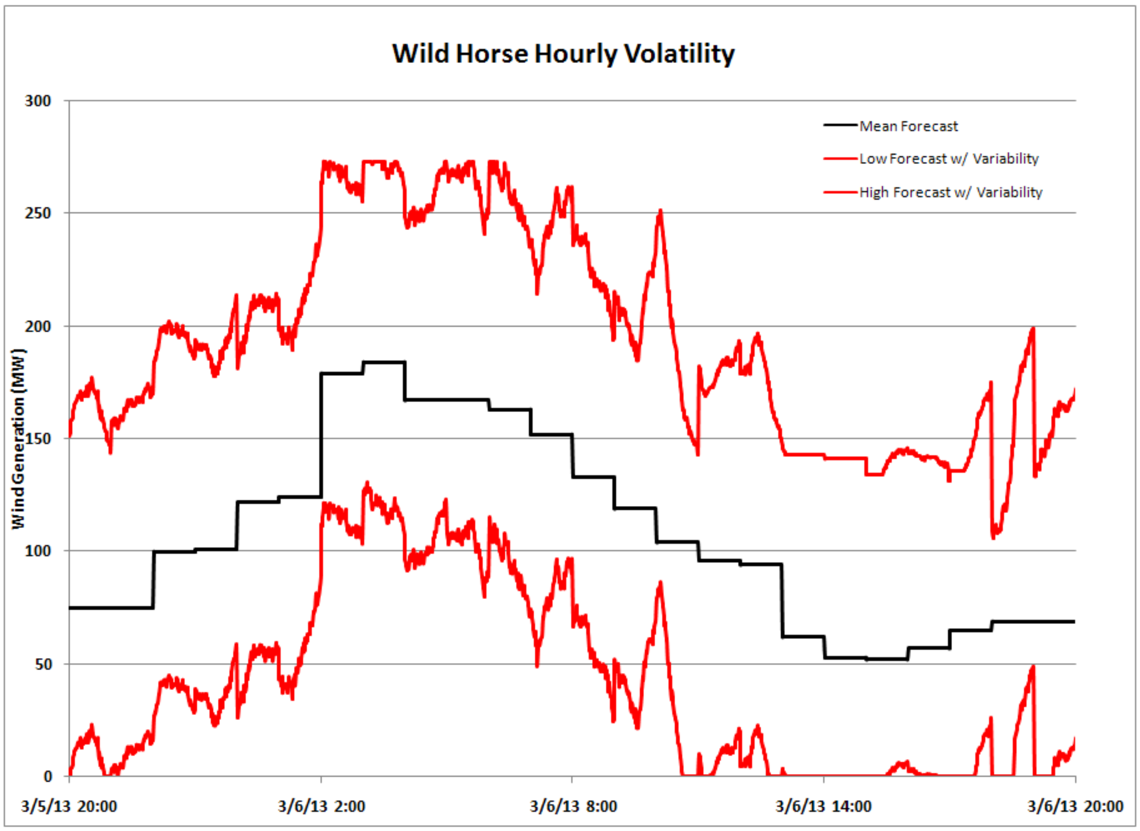
In reality, perfect foresight of wind generation or load for each upcoming operating hour is not possible. In Figure H-3, future wind generation is presented as an expected forecast for the next several hours, along with two additional forecasts that provide the probability of wind generation exceeding those values. At the 10% Exceedence forecast, we would expect actual wind generation to be above this value only 10 percent of the time, whereas at the 90% Exceedence forecast we would expect actual wind generation to be above this value 90 percent of the time. Actual wind generation may come in above or below the forecast, or, as is the case in HE 20 of March 6, 2013, it can exceed the forecasted bounds.

Figure H-3: Hourly Uncertainty in Wind Generation



The variability and uncertainty at Wild Horse are combined in Figure H-4 to illustrate the volatility that may be expected each hour. The actual variability observed around each perfect hour in Figure H-2 is imposed on the upper and lower probability forecasts from Figure H-3. It shows how PSE must balance potentially large blocks of energy related to forecast error (uncertainty) while simultaneously balancing within-hour fluctuations (volatility) in order to maintain system reliability. Addressing volatility from sources other than wind requires similar action on PSE's part.

Figure H-4: Hourly Volatility in Wind Generation



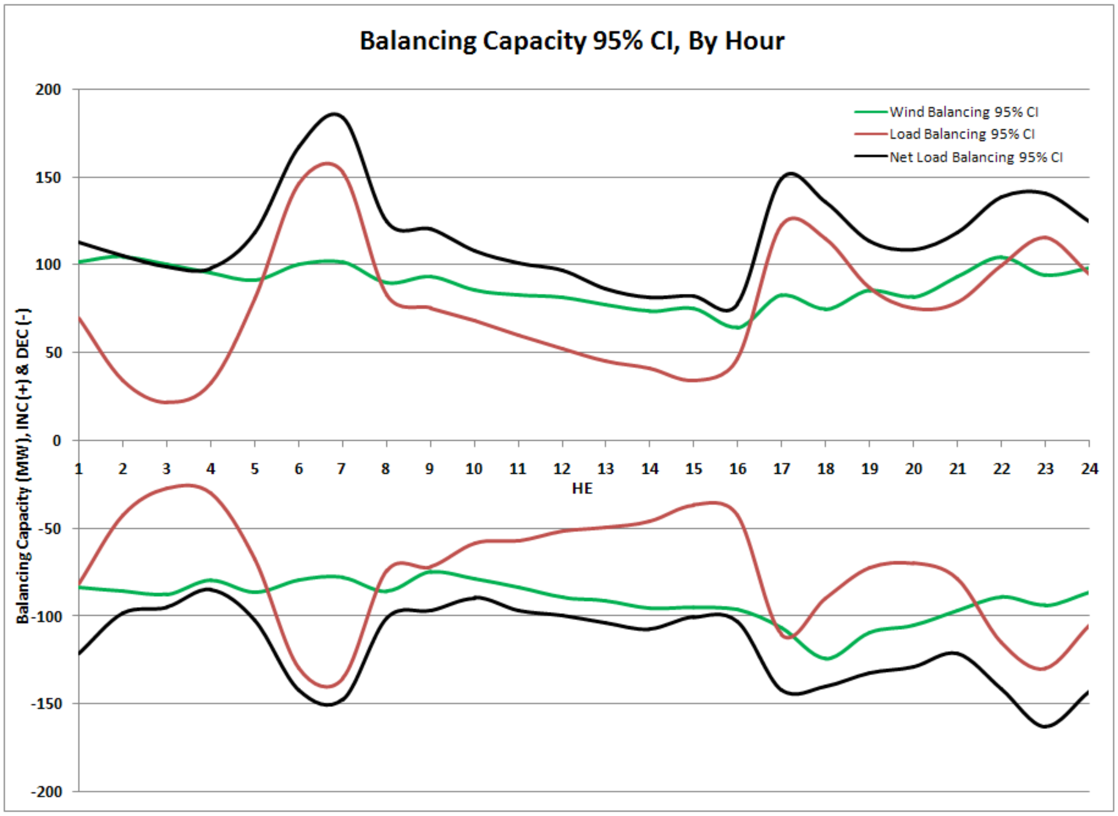
Managing Volatility

System volatility (variability and uncertainty) is managed with balancing reserves. Balancing reserves are generating capacity available to respond to changes in system conditions by either increasing generation (INC capacity) or decreasing generation (DEC capacity). The amount of balancing reserve capacity at PSE is determined by examining historical balancing capacity needs, and then establishing the amount of reserves necessary to cover 95 percent of the historical deviations in net load. This amount of balancing capacity is referred to as a 95 percent Confidence Interval level (95% CI) of reserves.

An overall 95% CI can be calculated that covers all time periods, but developing multiple 95% CIs can provide greater insight into balancing capacity needs. PSE develops 24 distinct 95% CIs for the entire day's operation. As Figure H-5 shows, the hourly 95% CI values can vary a great deal through the day for both load and wind resources. For load, large amounts of balancing capacity can be needed to manage strong load ramps to meet the 95% CI during morning and evening peaks.

For PSE wind resources, the 95% CI is more constant throughout the day, with a slight transition to more DEC capacity required in the evening and more INC capacity in the morning hours. The fixed range of potential wind generation, from 0 MW to full capacity, suggests the wind forecast can be a criterion for developing additional 95% CI. Taking the extremes, at a 0 MW wind forecast the only potential forecast error (forecast generation minus actual generation) PSE would need to balance is a negative error (forecast is less than actual generation), which would only require DEC capacity reserves. Conversely, when wind generation is forecast at full output, PSE would only need to manage positive forecast errors where the forecasted generation is greater than actual generation. In this case, INC capacity reserves are required.

Figure H-5: Hourly PSE Balancing Capacity at a 95% Confidence Interval



It is important to note that contingency reserves are accounted for separate from balancing reserves. Contingency reserves are dedicated to addressing short-term reliability in the event of forced outages; they cannot be deployed to address hourly system volatility unless a qualifying event occurs, such as a unit tripping off-line.

FLEXIBILITY SUPPLY AND DEMAND

System flexibility is the capability of PSE resources to manage system volatility over varying time periods, rates of change and overall magnitude. Flexibility is supplied by PSE generating resources, primarily PSE's share of the Mid-Columbia hydroelectric generating facilities (Mid-C), but also PSE's fleet of simple- and combined-cycle gas-fired units. Flexibility demand is created by the volatility observed in load, generation and transmission curtailments, and the uncertainty inherent in predicting loads, wind generation and unexpected events. Load and wind volatility are the two primary drivers of the demand for flexibility on the PSE system. Regional consensus on flexibility metrics is still developing, but PSE has begun to try to quantify the flexibility supply it has available to meet demand.

Flexibility Supply

All resources provide some measure of flexibility; however, the ability of a resource to supply flexibility is constrained by unit-specific characteristics including availability, operational or environmental limitations, range and ramp rate. These characteristics, coupled with economic dispatch generation set points, affect PSE's total supply of system flexibility.

Availability depends on whether the resource is online, the speed with which it can be dispatched if off-line, and whether it is out of service due to planned maintenance or unplanned outage.

In terms of **operational limitations**, the speed with which a resource can transition from off-line to generating and synced to the system is a distinguishing feature of the resources needed to supply flexibility. Resources that take several hours to properly prepare for dispatch, like combined-cycled units, are limited in their availability to respond to short-term system balancing needs.

Resource range refers to the physical and environmental (temperature) constraints that dictate the maximum and minimum levels at which a resource can generate. For any given resource, the difference between this maximum and minimum at any given time is referred to as its operating range. For conventional thermal resources, this range remains fairly constant, but the range for hydro resources changes dramatically during certain times of the year. A portion of PSE's capacity share of the Mid-C is available to meet PSE flexibility needs for most of the year, but during the spring runoff, high stream flows on the Columbia River reduce the available operating range on the Mid-C. At these times, hydro projects must generate at or near full capacity to avoid flowing excess water over spillways to meet water quality requirements. PSE's supply of flexibility is severely reduced at this time of year.

Resource ramp rates describe the speed at which a unit can increase or decrease its generation. The ramp rate determines the ability of a resource to respond to all, some or none of the system's deviations. Slow ramp rates effectively limit the balancing capacity of a resource during a given time increment. A resource with a large operating range but very slow ramp rate may be insufficient to address sudden changes in load and wind generation, while a resource with a small operating range and faster ramp rate can quickly respond to system needs but may not be able to sustain such a rate for an extended period, so multiple resources may need to respond simultaneously.

Flexibility Demand

The demand for flexibility is created primarily by system volatility, the need to manage the scheduled interchange ramp period between hours and potential system contingencies.

Volatility. Continuous demands for flexibility are placed on the system by volatility – the variability of loads and generating resources that fluctuate from moment-to-moment combined with the uncertainty inherent in forecasting load and wind resources hour by hour.

PSE addresses the demand placed by all system loads and resources simultaneously, rather than responding to each deviation individually. The relationship between load and wind is especially important. Because wind generation serves system load, load and wind scheduling errors in the same direction offset each other. The BA does not need to respond to an increase in load if there is an equal increase in wind generation. Load and wind schedule deviations in opposite directions create greater demands on system balancing resources. On a probabilistic basis, the fact that PSE load and wind may often move in the same direction or at the same rate places a smaller total demand for flexibility on PSE than if each were measured individually and then added together.

Scheduled interchange. In addition to managing loads and resources throughout each operating hour, PSE's BA must integrate hourly imports and exports. This is known as a scheduled interchange. Little volatility is associated with scheduled interchanges (they are generally a flat, hourly amount of energy), but the magnitude of scheduled interchanges can vary each hour, often by several hundred megawatts. To accommodate these large changes, resources are ramped in over a 20-minute period beginning 10 minutes prior to the start of the operating hour and ending 10 minutes after. Even with planned ramps, integrating such large changes in power can be demanding, both in the range required of resources and the speed with which they must respond.

System contingencies. Forced outages place significant demands for flexibility on the system because they create an immediate need for large increases in energy to replace the resource lost to the outage. Forced outages occur when a generating unit, transmission line or other facility becomes unavailable for unforeseen mechanical or reliability reasons.

PSE also faces forced outage-type events as other BAs manage their own system volatility. For example, all wind resources within the BPA BA, of which PSE has 500 MW, are subject to dispatcher instructions meant to address BPA's need for system flexibility at times when its system reserve capacity is exhausted. One notable BPA business practice is Dispatch Standing Order 216 (DSO-216). DSO-216 states that if wind plants are under-generating and BPA is supplying INC balancing reserves, BPA will have the ability to curtail transmission schedules for each plant, relative to the plant's actual generation. A schedule cut within the hour is like a forced outage in that the PSE BA must respond instantaneously to a potentially large loss of energy. In addition to wind schedule cuts, PSE's thermal resources located outside the company's BA can also be cut due to regional transmission congestion and maintenance requirements. Transmission congestion can mean within-hour schedule cuts of several hundred megawatts.

Procuring and Deploying Balancing Reserve Capacity

The balancing reserves required to manage system operations within every operating hour can be thought of in two phases:

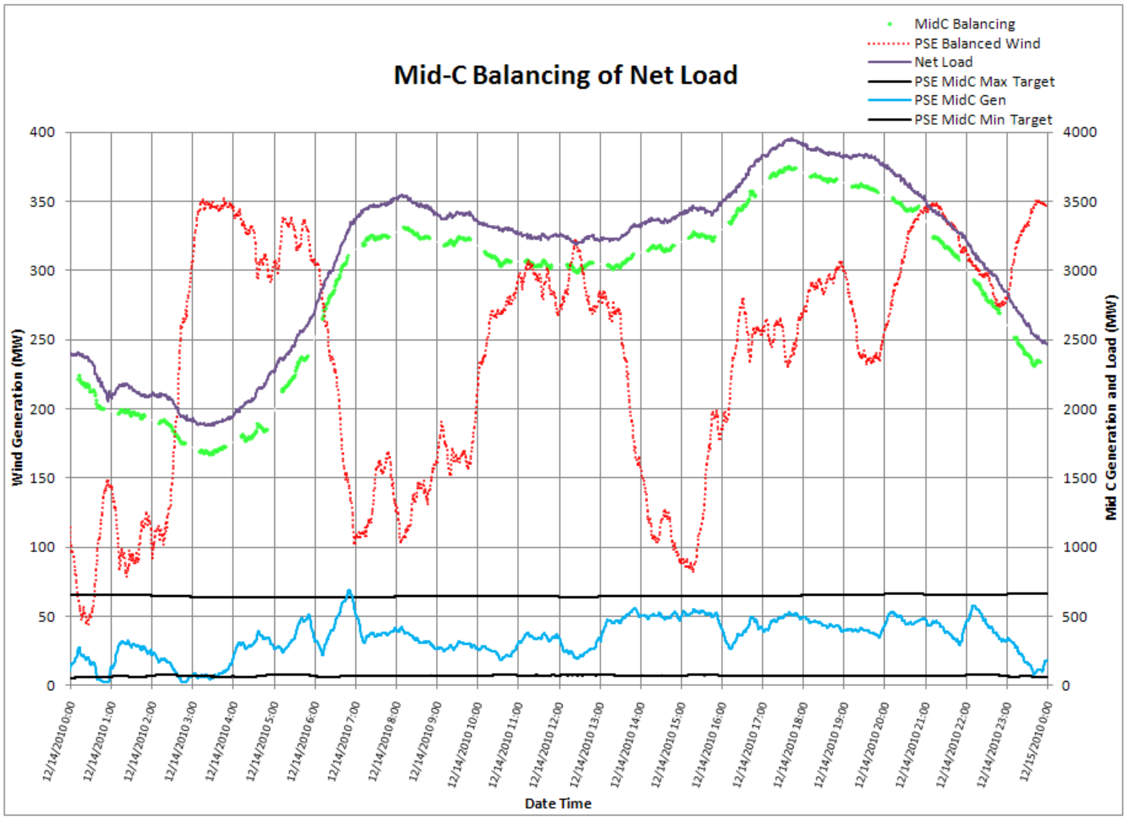
- the procurement of balancing reserve capacity ahead of the operating hour; and
- the deployment of reserves as balancing energy within the hour.

Procuring balancing capacity ideally consists of positioning hydro assets to allow sufficient room to increase generation (INC capacity) or decrease generation (DEC capacity) as needed within the operating hour. Thermal resources (gas and coal) can also be dispatched to provide balancing capacity. It should be noted that procurement of the needed balancing reserve capacity does not always guarantee sufficient flexibility is available to meet actual net load deviations on the system in real time. Meeting the demand for flexibility also requires unit ramp rates that can effectively deploy the capacity procured.

Figure H-6 depicts all aspects considered for balancing capacity and addressing system flexibility. In this 24-hour example, PSE's Mid-C generation is the source of balancing capacity. The moment-to-moment changes in net load (load minus wind generation) are represented by the purple trace. The blue line representing Mid-C generation is bounded by black minimum and maximum generation targets.

The green trace labeled "Mid-C Balancing" represents the slope, or rate of change in Mid-C generation for each hour. It is presented just below the net load trace in order to highlight how the Mid-C generation is changing within the hour relative to the change in net load. The trace shows that during each hour, the Mid-C is responding in unison with changes in net load. The flexibility of the Mid-C is most evident during the 6:00 to 7:00 a.m. period as it manages an extreme load ramp of nearly 500 MW (over 8 MW per minute through the entire hour).

Figure H-6: Balancing of Net Load with Mid-C Generation



Note how the Mid-C reacts during the 20-minute schedule interchange period, from 5:50 to 6:10 am and from 6:50 to 7:10 am. During these periods Mid-C generation is being pushed down to accommodate new imports and to provide incremental balancing services for the next hour. In these instances, Mid-C frequently changes generation levels by 500 MWs over a 20-minute period (25 MW per minute ramp rate). No other resource in PSE's fleet is capable of this combination of speed and range. This is why Mid-C hydro is such an important flexibility resource in PSE's portfolio.

MODELING METHODOLOGY

This analysis focuses on whether PSE has enough flexibility supply to meet system demands and ancillary obligations, and how the costs of meeting those demands can be quantified.

The cost of supplying flexibility takes three forms.

- **Reliability.** Uncertainty about the levels of generation and load can result in more frequent deployment of contingency reserves or a reduction in PSE's CPS2 score.
- **Market opportunity cost.** Procuring reserves can constrain PSE's operations, because flexibility demands may require PSE to adjust the amount of available PSE-owned dispatchable generation in a manner contrary to market signals.
- **Physical wear and tear on units.** Ramping up generating units to take advantage of their operational range rather than operating them at their most efficient generating point tends to shorten maintenance timetables. Maintenance costs are difficult to estimate on a pro forma basis, however, and are not included in this 2013 IRP analysis. As we collect more cost data related to system flexibility requirements, maintenance costs may become possible to model.

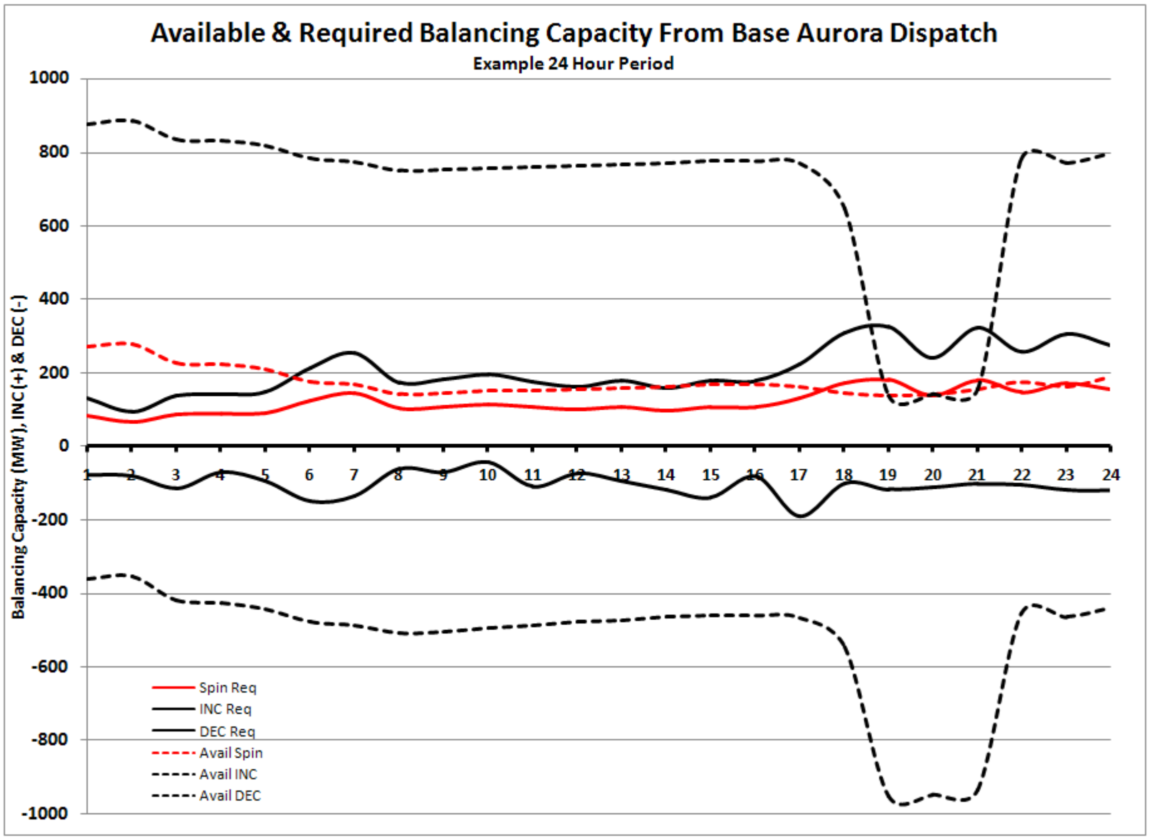
2015 IRP Update: *PSE has completed an update on operations and maintenance (O&M) costs for gas-fired resources. The updated cost assumptions will be included in future flexibility analyses.*

Hour-ahead Methodology

The Aurora® production cost model used in the IRP does not feature the ability to set reserve capacity constraints on the PSE system. As a result, the hourly dispatch of generation produced by Aurora does not necessarily provide adequate balancing capacity each hour to meet the demands experienced by PSE. For this reason, the procurement of hour-ahead reserve capacity is modeled outside of Aurora.

Figure H-7 shows an Aurora dispatch in which there is inadequate spinning capacity during HE18 – HE21 and inadequate INC balancing capacity during HE19 – HE21. Adjustments to the dispatch must be made outside the Aurora model to provide sufficient balancing capacity, because Aurora does not take into account PSE-specific balancing capacity requirements in its optimization.

Figure H-7: PSE Balancing Capacity, Based on Aurora Economic Dispatch



Based on historical deviations in load and hourly wind in PSE's balancing authority, a 95% CI of INC and DEC balancing capacity was determined for each hour of the Aurora dispatch, and for the contingency reserve requirement. Setting aside this amount of balancing capacity every hour, PSE would expect to capture 95 percent of deviations in load and wind.

Once balancing reserve capacity requirements were set for each hour, the Aurora economic unit dispatch and price simulations were fed through a mixed-integer linear program in SAS-OR. This model adjusted the dispatch of PSE's Mid-C hydro generation and 13 gas-fired resources to provide the required balancing capacity over a 24-hour period. Net changes to internal PSE dispatch were offset by market transactions to maintain hourly load-resource balance.

Once adjustments were completed, economic costs were tabulated based on the hourly changes to PSE's market position for power and the fuel costs associated with dispatching off-line gas-fired units or re-dispatching those units to less efficient points on their heat-rate curves. Statistics on unit operations can be gathered from the adjusted dispatch. Finally, if the stack of PSE resources was unable to procure balancing capacity to fulfill the 95% CI in any hour, the hour was flagged and the balancing capacity shortfall was recorded.

Intra-hour Methodology

To model intra-hour deployment of balancing capacity, the adjusted unit dispatch from the hour-ahead model was converted into 10-minute dispatch increments. Aurora's hourly wind and load values were then treated as hourly schedules, and 10-minute profiles were simulated based on the historical behavior of PSE load and wind resources. The simulated profiles represent deviations from the hourly schedules that require generation to be dispatched to return the system to equilibrium. The hour-ahead resources identified in the previous step were eligible to respond to the net change in load and wind. This also ensured that balancing capacity was held to meet PSE's contingency reserve obligations.

The intra-hour model also uses a mixed-integer linear program in SAS-OR. Redispatch of internal generation was guided by unit economics and operating characteristics. Each unit was constrained by its ramp rate, minimum and maximum generation points, minimum runtime, minimum downtime and any forced outages modeled by Aurora. The optimization horizon was limited to 3 hours to reflect the limited foresight system operators have when making within-hour unit decisions. The output from the model was a record of unit deployment for PSE's dispatchable generation that quantified how each unit contributed to system balancing, pinpointed periods of stress, and identified periods when the model could not balance the system.

Modeling Assumptions and Limitations

Some key assumptions made in these modeling efforts should be noted. These relate to Aurora and the Mid-C data used in the analysis.

Relying on Aurora unit dispatch and price information as inputs to the model allows for continuity between the primary production cost calculation and the subsequent modeling of system balancing, but it also assumes the Aurora dispatch reflects a realistic portrayal of hour-by-hour unit dispatch and system conditions and this is not certain.

The uncertainty arises partly from the Mid-C hydro dispatch profiles used in Aurora, which are based on 70 years of historical hydro generation beginning in 1929. These profiles reflect conditions that prevailed many decades ago, but that may not exist today, or may not accurately mirror the current demands on PSE's system. As discussed previously, hydro dispatch (accessed through Mid-C contracts) is a primary flexibility resource for PSE because it is already synchronized to the system, it has enormous range, it responds instantaneously, and it ramps quickly. Therefore, any inputs that overstate or overly constrain Mid-C availability can have a dramatic impact on the results.

The current models do not make net MWh changes to the Aurora hydro dispatch; generation may be moved between hours but daily, monthly and annual MWh Mid-C generation is constant between the initial Aurora dispatch and the resulting Mid-C generation profile from the model.

RESULTS

For this analysis, a fifty-simulation subset of the 250 Aurora IRP simulations were analyzed, limited to the year 2018. The results are divided into two sections: The first looks at the hour-ahead availability and procurement of balancing capacity, and the second looks at intra-hour deployment of those reserves. The hour-ahead supply of capacity is expressed as the contribution of PSE resources to the total balancing capacity available, while intra-hour demand is input as hourly 95% CI. Once the portfolio is positioned hour-ahead, meeting the system's flexibility demands was simulated with intra-hour load and wind deviations, hourly scheduled interchanges, and forced outages modeled by Aurora.

The analysis first assessed the ability of the lowest reasonable cost portfolio identified in the analysis for the 2013 IRP Base Scenario to balance these deviations. Then, three additional portfolios were analyzed. Each introduced one additional resource to this portfolio: a CCCT resource, a frame CT resource, and a reciprocating engine CT. Basic operational characteristics of the units are identified in Figure H-8. By comparing these three portfolios to the Base Scenario's least-cost portfolio, PSE can assess potential benefits to system reliability and reductions in portfolio balancing costs associated with the added resource.

Figure H-8: Overview of Resource Additions Analyzed

Unit	Capacity (MW)	Min Generation (MW)	Heat Rate (Btu/kW)*	10-Minute Ready
CCCT**	343	189	6,682	No
Frame CT	221	133	10,324	Yes
Recip CT	18	9	8,370	Yes

**Heat rates based on 2013 IRP assumptions for 2017*
***Duct-firing portion excluded from analysis*

Demand for Hour-ahead Balancing Capacity

Figure H-9, below, translates the hourly 95% CI levels (the balancing capacity PSE should carry to manage 95 percent of load and wind deviations) into a monthly average. These values reflect PSE balancing obligations based on the study assumptions for 2018, and they act as input constraints on the PSE system during the modeling phases. Capacity requirements are expressed as monthly amounts of spinning capacity, INC capacity, and DEC capacity required to meet the total 95% CI. Spinning capacity is a specific type of INC capacity for which resources must already be online and synchronized to the system. The remainder of INC requirements can be met with capacity from off-line, 10-minute-ready resources, or spinning capacity in excess of the minimum spin requirement. In Figure H-9, the spinning and INC capacity requirements include the capacity necessary to meet the contingency reserve obligation.

Figure H-9: Average Hourly Balancing Capacity Requirements (MW) for 2018

Month	Avg. Spin Capacity Required	Avg. INC Capacity Required	Avg. DEC Capacity Required
1	112	188	113
2	103	171	104
3	107	178	114
4	100	165	101
5	85	135	100
6	86	137	97
7	93	150	94
8	99	164	101
9	96	158	90
10	103	171	100
11	110	185	115
12	109	183	114

Supply of Hour-ahead Balancing Capacity

To benchmark the initial state of the PSE system, available balancing capacity from the unaltered Aurora dispatch is tabulated by asset class for the 2013 IRP Base Scenario's least-cost portfolio for the year 2018. These values are presented as average hourly amounts of balancing capacity available in Figure H-10. (In reality, however, each individual hour's available balancing capacity can vary widely as market conditions dictate unit dispatch and therefore the actual balancing capacity available.)

Figure H-10: 2013 IRP Base Scenario Portfolio,
Average Hourly Balancing Capacity Available, Initial Aurora Dispatch (MW)

Month	Mid-C Spin	Mid-C DEC	CT Spin	CT INC	CT DEC	CCCT Spin	CCCT INC	CCCT DEC
1	141	280	0	587	39	10	10	135
2	230	225	0	544	64	6	6	179
3	214	201	0	524	58	5	5	163
4	162	189	0	417	71	3	3	148
5	137	124	0	416	42	5	5	63
6	66	95	0	511	17	10	10	70
7	150	158	0	521	45	16	16	146
8	217	168	0	474	81	17	17	200
9	315	89	0	433	106	7	7	215
10	229	129	0	534	46	11	11	200
11	244	187	0	569	41	16	16	167
12	266	217	0	542	71	7	7	177

At this level of granularity, the Aurora dispatch reflects the importance of the Mid-C hydro contracts by illustrating that for the least-cost portfolio in the 2013 IRP Base Scenario, this single resource is sufficient to meet balancing capacity requirements during most of the year. No spinning capacity is provided by the CT fleet (8 units); the Aurora dispatch will commit those resources to their maximum generation. However, when dispatched, the CT resources provide their full operating range as DEC capacity. The CCCT fleet is similar to the CTs. Typically they are dispatched to their maximum generation and rarely provide spinning capacity. At times they may be dispatched to their minimum generation point during brief uneconomic periods of a much longer economic dispatch, at which time they are able to provide some spinning capacity.

The reduced availability of balancing capacity from May through July is due to a confluence of system conditions. Hydro runoff conditions can severely limit the availability of balancing capacity of the Mid-C projects as spring stream flows must pass through turbines to avoid violating environmental constraints related to excessive spill. The abundant hydro generation depresses market prices, reducing the economic commitment of gas-fired units. And finally, due to the predictability of these hydro and market conditions, annual maintenance for CT and CCCT resources is typically scheduled during this time to align their outages with periods of unlikely dispatch.

To address any hours where there is insufficient balancing capacity, unit dispatch is adjusted until the capacity requirements are met. In Figure H-11, the average hourly available balancing capacity is presented after hourly adjustments are made to the unit dispatch of the 2013 IRP Base Scenario portfolio in 2018.

Figure H-11: Average Hourly Balancing Capacity Available, Adjusted 2018 Base Portfolio (MW)

Month	Mid-C Spin	Mid-C DEC	CT Spin	CT INC	CT DEC	CCCT Spin	CCCT INC	CCCT DEC
1	141	280	26	570	49	16	16	129
2	230	225	8	525	78	6	6	179
3	214	201	10	515	64	4	4	164
4	162	189	17	409	75	9	9	142
5	137	124	25	406	48	3	3	64
6	66	95	43	477	40	17	17	62
7	150	158	14	508	54	19	19	142
8	217	168	8	458	92	14	14	202
9	315	89	0	415	119	8	8	214
10	229	129	0	525	53	11	11	201
11	244	187	1	563	44	8	8	175
12	266	217	1	537	73	7	7	177

The static nature of Mid-C availability is due to a pond constraint imposed on the model, and the level at which these values are presented. If the Mid-C generation is increased by 1 MW in a given hour, this results in a 1 MW addition to DEC capacity and a 1 MW decline in available spin capacity. However to maintain pond balance, this extra 1 MW of generation must be offset by a 1 MW decrease in generation in another hour, which will also lead to inverse changes in the available spin and DEC capacity. At an hourly level the available capacity on the Mid-C is changing, yet the arithmetic for the monthly averages does not show this change.

Only small changes in the available capacity on the CCCT fleet are present. Since these resources are not capable of being ready to dispatch in 10 minutes, they are normally called on only when the resource is already online. In actual practice, CT units are frequently called on more often than in the initial Aurora dispatch, especially during the first half of the year, because of the increased availability of their spinning capacity and DEC capacity. In the fall, there is no change in spin capacity, however, CT resources are being dispatched at maximum generation more frequently to support DEC capacity needs.

Hourly results from the four portfolios show that PSE has adequate hour-ahead balancing capacity (Figure H-5). Across the 50 simulations, approximately two hours of unmet balancing capacity were expected over the entire study year; this primarily involved DEC capacity shortfalls. The shortfalls do not necessarily indicate a failure to balance the PSE system; rather, they indicate hours when PSE is unable to fully meet the 95% CI set aside of balancing reserves, which may or may not be needed in that hour. However, the contingency reserve portion of the spinning capacity and INC capacity are requirements that PSE must meet every hour. Investigation of the hours with either unmet spin or unmet INC capacity reveals that none of the shortfalls impact our ability to meet contingency reserve obligations.

Figure H-12: Summary Hour-ahead Balancing Results, 50 Simulations

2013 IRP Base Scenario Portfolio	Avg. Unmet Spin Capacity (Hrs)	Avg. Unmet INC Capacity (Hrs)	Avg. Unmet DEC Capacity (Hrs)	Avg. Unmet Spin Capacity (aMW)	Avg. Unmet INC Capacity (aMW)	Avg. Unmet DEC Capacity (aMW)
2018 Base	0.1	0.3	1.9	0.5	9.1	17.3
2018 Base + CCCT	0.1	0.3	1.7	0.5	9.1	15.7
2018 Base + Frame CT	0.0	0.0	0.2	0.0	0.0	0.0
2018 Base + Recip CT	0.2	0.3	1.2	0.1	8.5	10.5

Intra-hour Flexibility Results

Once balancing capacity has been set aside in the hour-ahead time frame, the simulated 10-minute level wind and load deviations were introduced, along with the need to balance hourly shifts in scheduled interchange. Then the portfolios were assessed on their ability to respond.

The modeled deployment of PSE balancing resources revealed that PSE can maintain a high degree of reliability; in all portfolios, the expected proxy CPS2 score is 97 percent, well above the requirement of 90 percent. (This does not include frequency bias.) The score reflects a very aggressive constraint in the model, which is set to balance load and resources exactly every 10 minutes. The times when load and generation are not in balance fall into two categories, unserved energy and excess energy. Unserved energy is when the system load is greater than the amount of energy provided by PSE resources, while excess energy is when resources are over-generating relative to demand. While the model solves to have no imbalances, in actual operations small differences in system demand and net resources are permissible over short periods of time, as reflected in the CPS1 and CPS2 metrics. The magnitude of these violations is usually small. Periods of unserved energy average an imbalance of 6 MW, periods of excess energy average a 12 MW deviation.

PSE must also maintain spinning capacity to meet its contingency reserve obligation. Each portfolio has only a handful of 10-minute periods with insufficient spinning capacity, and during those periods the average capacity shortfall is 2 MW.

Figure H-13: Summary Results from Flexibility Analysis, 50 Simulations

2013 IRP Base Scenario Portfolio	CPS2 Score Proxy (%)*	Spin Capacity Shortfall (%)	Spin Capacity Shortfall (aMW)	Unserved Energy (aMW)	Excess Energy (aMW)	Expected Annual Balancing Savings ($)	Expected Annual Bal. Savings ($/kW Capacity)
2018 Base	97%	0.1%	2.0	5.9	12.5	--	--
2018 Base + CCCT	97%	0.1%	1.8	5.7	12.2	$800,000	$2.33
2018 Base + Frame CT	97%	0.1%	1.9	5.9	12.1	$1,037,000	$4.69
2018 Base + Recip CT	97%	0.1%	1.8	5.9	12.1	$328,000	$18.23

**NERC CPS2 metric requires a score of 90% or greater*

As the 2013 IRP Base Scenario portfolio's set of balancing resources are flexible enough to balance the PSE system, the addition of another resource to the portfolio does not have much room to further improve these reliability metrics. However, this result should not diminish the value of these resources to improve system reliability and flexibility. In addition to the flexibility attributes they bring to the portfolios, they also lower the cost of providing and deploying balancing capacity. Adding a new balancing resource to the portfolio may provide a lower-cost means to meet system reliability than previously existed, although further cost analysis is required.

The annual savings in Figure-13 for each resource addition is the expected reduction in annual production costs compared to the 2013 IRP Base Scenario portfolio as measured by fuel consumption, market purchases and sales associated with providing and deploying balancing capacity. As this value only considers production costs, it is worth noting the savings may be larger or smaller when secondary effects are considered, such as changes in maintenance needs or availability factors.

The expected benefit from adding the CCCT resources is $800,000. As the CCCT is not 10-minute ready it can only contribute to balancing capacity and adjust to meet load and wind deviations if it has already been economically dispatched by Aurora. The unit's efficient heat rate sees it dispatched 57 percent of the time in the simulations analyzed, and the unit's large operating range can manage in-hour changes that may otherwise have required multiple units to move. With respect to the two CT resources, the expected annual benefit is $1 million for the frame CT and $328,000 for the reciprocating engine CT. They are dispatched by Aurora less frequently than the CCCT resources, 30 percent of the time for the frame and 32 percent of the time for the reciprocating engine. However, their 10-minute ready status means they can be dispatched as necessary during the hour. On a benefit-per-capacity basis, the reciprocating engine CT represents the highest value at $18.23 per kW, followed by the frame CT at $4.69 per kW, and finally the CCCT at $2.33 per kW.

What distinguishes the two CT units is their relative size. While the frame CT has a large operating range, its minimum generating level is relatively high. Dispatching this unit from an off-line state when there is a small incremental energy need (less than the 133 MW minimum operating level for the unit) may not be beneficial as it could trigger an excess energy situation unless another unit was available to offset it with decremental capacity. On the other hand, the reciprocating engine's smaller nameplate capacity, operating range, and low minimum generation level make it an ideal resource when there is a marginal energy or spinning capacity need.

CONCLUSION AND NEXT STEPS

While additional work needs to be done, given the assumptions made for this study, the analysis indicates PSE has sufficient capacity and flexibility in the 2013 IRP Base Scenario portfolio to effectively manage its known system flexibility demands in 2018 across both hour-ahead and intra-hour time frames. Comparing three different additions to that portfolio indicates potential production cost savings of $300,000 to $1,000,000 annually, and provides insight into how differing unit characteristics can alter potential balancing benefits.

Perhaps most valuable has been the change in perspective to a more comprehensive view of operational flexibility needs and costs. Efforts to expand on this work are already underway. Further exploration of the maintenance stresses placed on the system by balancing needs, the operational complexity associated with rapid deployment of multiple resources, and the capabilities of different types of resources are primary areas of interest to PSE. The current models use stringent constraints to maintain load-resource balance and will utilize all resources, if necessary. Understanding how increased resource use potentially changes a resource's operational abilities will help us carry out even more rigorous assessments of operational flexibility.

REGIONAL TRANSMISSION RESOURCES

Contents

The Pacific Northwest's regional transmission system and policies have undergone significant change and reform over the last several years. This change is marked by increasing frequency and duration of transmission constraints, changes in transmission policy and transmission projects, and promising steps in studying and implementing regional transmission solutions.

Of these items, some stand out as particularly important.

OVERVIEW

Existing flowgates and paths managed by the Bonneville Power Administration (BPA) continue to experience congestion resulting in curtailment. BPA has identified and implemented new flowgates and paths on its system to help manage congestion, signaling the increasingly strained nature of the transmission system and the increasing risks of curtailment.

Analysis of internal PSE transmission constraints in the Puget Sound area continues to be refined as generation alternatives are considered.

With the completion of BPA's Network Open Season (NOS) in the summer of 2014, BPA has identified several transmission projects required to grant new transmission service requests. ColumbiaGrid[1] and its members have completed several studies and developed transmission reinforcement plans to help alleviate regional congestion. PSE will continue to look to ColumbiaGrid to provide the region with an understanding of where future transmission reinforcements should occur and which projects or facilities will be most effective.

These items will be explored in the sections below.

1 / ColumbiaGrid is a non-profit membership corporation formed to improve the operational efficiency, reliability and planned expansion of the Northwest transmission grid. Members include Avista, BPA, Chelan County PUD, Grant County PUD, PSE, Seattle City Light, Snohomish County PUD and Tacoma Power.

THE PACIFIC NORTHWEST TRANSMISSION SYSTEM

Regional Constraints

BPA provides roughly 75 percent of the high-voltage transmission in the Pacific Northwest region. Historically, PSE and other regional utilities have relied on BPA's transmission system to deliver energy to serve retail customers. However, as PSE and the region's resource portfolios have grown in conjunction with increasing loads and renewable energy standards, the Pacific Northwest's transmission system has not kept pace with the expanding demands. As a result, the region experiences transmission constraints during various times of the year, sometimes resulting in curtailments of firm contractual transmission rights.

The situation poses an operational challenge for PSE in particular, since PSE moves significant amounts of energy and capacity resources to the west from eastern Washington (east of the Cascades) and from the south along the I-5 corridor and into the Puget Sound area.

What is a constrained path?

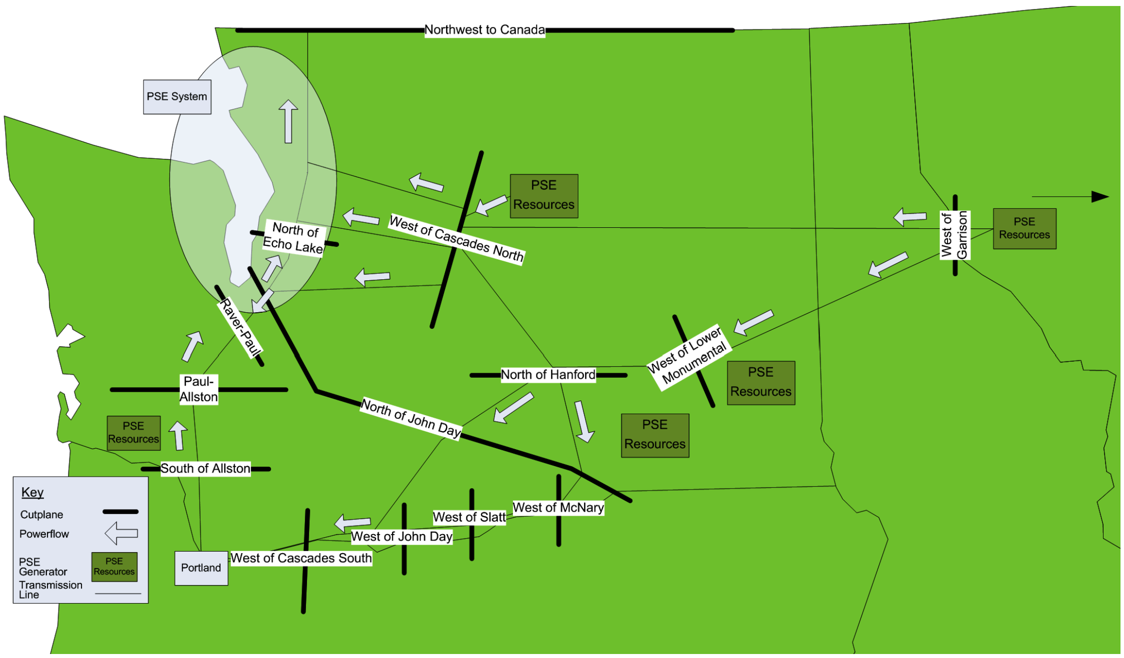
Constrained paths and flowgates are sets of transmission lines that are nearly "full." They have little capacity available to sell, which makes them vulnerable to congestion and curtailment.

What is curtailment?

Curtailments occur when scheduled transmission service must be canceled due to physical constraints.

Figure I-1 illustrates how power travels from remote resources, generally located south of Seattle and east of the Cascades, to PSE's service area. The thick, black bars in Figure I-1 represent a flowgate or path, often consisting of several transmission lines or sets of parallel lines. The flow of power is indicated by the arrow symbol.

Figure I-1: BPA Transmission System Constraints on PSE Remote Resource Delivery



A summary of the most significant flowgates and paths shown in Figure I-1 are discussed below.

- The majority of energy from PSE's eastern Washington resources flow across the constrained West of Cascades North flowgate and into the Puget Sound area. This flowgate is most constrained during heavy winter loading periods.
- A portion of the energy flowing from eastern Washington resources also flows over the West of Cascades South flowgate, and in the process of traveling to loads in the Puget Sound area, it flows over the North of John Day and Raver – Paul flowgates. The West of Cascades South flowgate is most constrained during heavy winter loading periods, while the North of John Day and Raver – Paul flowgates are typically most constrained during heavy summer loading periods.
- Energy from PSE's resources in Montana flow over the West of Garrison path.
- Congestion issues in the Puget Sound area are monitored by the North of Echo Lake flowgate. Generation support from PSE resources located in Skagit and Whatcom Counties is particularly important in reducing curtailment risk on this flowgate.
- Energy from PSE's Lower Snake River Wind Project flows across the West of Lower Monumental flowgate.

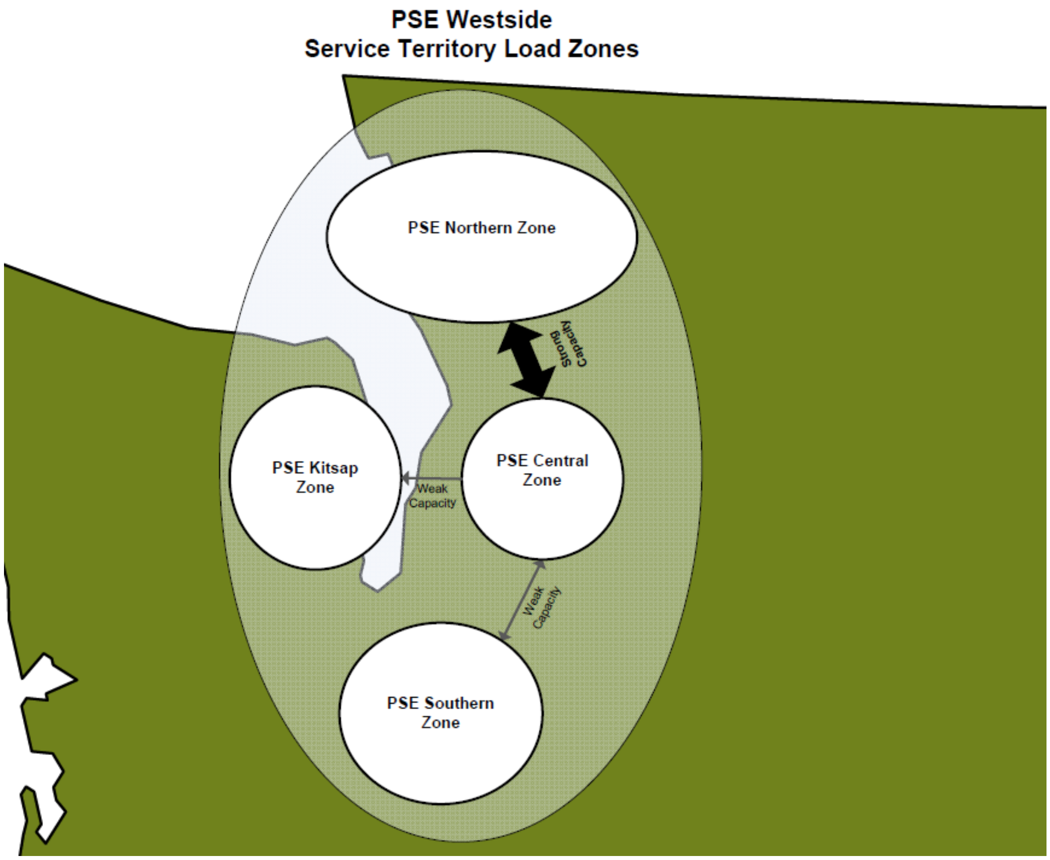
Some paths are designed to operate close to their limits (like West of Garrison), others are not; this latter group presents areas of the system where PSE sees a particular importance in continuing to study, develop and possibly construct new transmission.

PSE Westside Transmission Constraints

Generally, resources located west of the Cascades near PSE load centers and natural gas pipelines have fewer delivery constraints because they are located next to the company's own local transmission system. Currently, there is sufficient transmission capacity on PSE's westside system to move surplus energy produced in one part of the service territory to another part that is experiencing a deficit. However, in certain areas, constraints could develop within the system if new resources are added or imported.

Figure I-2 illustrates the PSE Westside Load Zones and transmission paths.

Figure I-2: Transmission System Constraints on PSE Internal Resource Delivery



The illustration above divides PSE's Westside Service Territory into four geographic load areas, connected by different sets of transmission facilities. The arrows indicate relative transmission capacity between the load areas; the thicker the arrow, the greater the transmission capacity.

- Capacity from the Central Zone to the Northern Zone is adequate in the near term. In the ten-year time frame examined here, it is unlikely that new resources located in (or imported into) the Central Zone would cause PSE to experience limitations in moving energy from the Central to the Northern Zone.
- Transmission capacity from the Central to Southern Zone is more limited. Here, PSE could experience limitations in moving energy from the Central to the Southern Zone if new resources are added or imported in the next ten years.
- In the Kitsap Zone, PSE may begin to see resource deficits after 2024 unless new transmission capacity is built or obtained between the Central or Southern Zones and the Kitsap Zone.

Purchased power agreements (PPAs) also impact energy transfer needs, as do capacity constraints, the geographic location of PSE's loads and existing resources, and the physical delivery points of remote resources.

PSE will consider these implications as we continue to analyze and study the location of loads, existing resources and transmission limitations.

PSE TRANSMISSION EFFORTS

There may be opportunities for PSE to join with other regional utilities on transmission projects to solve congestion issues in the Pacific Northwest. PSE is considering the following regional transmission projects.

Puget Sound Area / North of Echo Lake / Northern Intertie

As part of the ColumbiaGrid "Transmission Expansion Plan for the Puget Sound Area," PSE has committed to addressing Puget Sound area congestion through rebuilding its Sammamish – Lakeside – Talbot 115 kV lines from 115 kV to 230 kV (or a similar performing alternative). This is part of PSE's Energize Eastside project. Only one line will initially be energized at 230 kV. This will significantly increase reliability and reduce curtailment risk for imports into the Puget Sound area. This project is discussed further in the ColumbiaGrid section below.

West of Cascades North

Near-term improvements to the West of Cascades North flowgate will be constructed solely by BPA (see Attachment K section below), but long-term solutions could be improved through joint transmission development. As identified by the ColumbiaGrid Cross Cascades North Study team, the most effective transmission project for the West of Cascades North flowgate is the Chief Joseph – Monroe 500 kV #2 transmission line. PSE will continue to participate in the study team and work with regional utility partners to determine the most beneficial transmission project and construction time for West of Cascades North transmission improvements.

BPA TRANSMISSION EFFORTS

Network Open Season (NOS)

The primary option for acquiring contractual transmission in the Northwest is through BPA. Historically this involved submitting an OASIS (Open Access Same-time Information System) transmission service request to BPA, but the agency now requires participation in its Network Open Season (NOS). The NOS process was designed to obtain financial commitments from transmission customers in advance of any new facility construction. For long-term transmission requests, the process uses cluster studies to analyze impacts and new transmission facility requirements on an aggregated basis. Commencing in 2008, and in accordance with Federal Energy Regulatory Commission (FERC) approval, BPA initiated an NOS process under its Open Access Transmission Tariff (OATT). The multi-step process began with the submission of Transmission Service Requests (TSR) by transmission customers. BPA responded with a Precedent Transmission Service Agreement (PTSA) that requires customers to pledge a security deposit equal to the charge for 12 months of transmission service at the tariff rate. The PTSA obligates the customer to take service for its TSR if BPA satisfies the following conditions:

- BPA determines that it can reasonably provide service for the TSR in the cluster at embedded cost rates, and
- BPA decides to construct the facilities required to provide the service after completing an environmental impact study.

2013 NOS Findings. BPA released the findings of its 2013 NOS study on April 30, 2014. They include the following.

1. No transmission expansion was necessary to accommodate the potential exchange of transmission facilities with Idaho Power (or any other TSRs that affect the flowgates impacted by this potential asset exchange).
2. 5 TSRs totaling 166 MW could be authorized without further system expansion beyond any requirements identified in Large Generator Interconnection Procedure studies.
3. 30 TSRs totaling 2,505 MW could be offered assuming that the 2008 and 2010 NOS projects and other reliability-based projects were completed as planned.
4. 15 TSRs totaling 1,002 MW require completion of 2008 and 2010 NOS and other planned reliability-based projects as well as one or more new projects identified in the 2013 NOS.

Potential future projects identified in the 2013 NOS include:

- For BPA: upgrade Monroe – Novelty Hill 230 kV
- For PSE: Portal Way area 230-115 kV transformer

The next NOS was originally scheduled to begin in the fall of 2015, but has been delayed indefinitely, pending BPA policy decisions.

Past NOS Findings. From the 2008 NOS, BPA authorized four transmission reinforcement projects. These included the following.

- McNary – John Day 500 kV line (completed)
- Big Eddy – Knight 500 kV (to be complete by the end of 2015)
- Central Ferry – Lower Monumental 500 kV (to be complete by the end of 2015)
- I-5 Corridor Reinforcement Project (estimated completion, end of 2021).

There were no additional projects identified in 2009. In the 2010 NOS, BPA authorized the Northern Intertie Reinforcement Project. This project will help to integrate thousands of megawatts of new resources into the Northwest.

Wind Curtailments

Wind power plays a significant role in meeting the region's future energy needs and satisfying RPS requirements. In fact, approximately 5,000 MW total of renewable generation (predominantly wind power) will be necessary to fulfill the combined RPS requirements of Washington and Oregon. To meet this increase, BPA must continue to build transmission lines and substations to deliver renewable electricity from new wind projects that are often located in remote areas. Integrating this amount of wind energy into the region’s electrical grid poses many challenges, and BPA’s role will certainly require innovative and cooperative approaches to manage the variability of wind power effectively. Current BPA efforts to manage wind energy include the following.

Dispatcher Standing Order (DSO) 216. DSO 216 enables BPA to either curtail generation schedules or limit generation to the scheduled amount when there is insufficient regulating capacity on the federal hydroelectric system. Regulating capacity is an ancillary service that BPA provides to integrate wind. However, that service is not always available, as shown by the historical frequency of DSO 216 curtailments. Curtailments may result in lost energy and/or renewable energy credits (RECs) without compensation.

Oversupply Management Protocol. Similar to DSO 216, BPA uses Oversupply Management Protocol to curtail wind energy, but in this case when there is an oversupply of hydroelectric and wind generation in the region. Curtailments may result in lost energy and/or RECs with compensation.

PSE's future resources – especially renewables – will most likely face tough economic and technical challenges, along with business uncertainties. Continuing to rely on BPA to integrate our wind resources has a limit, which means we must continue to look for alternatives to integrate wind either directly into our Balancing Authority (BA), or seek other innovative, lower-cost approaches.

BPA Transmission Planning and Attachment K[2] Projects

Through its various forums (Attachment K, Capital Investment Review), BPA is planning to construct one project that is particularly important for PSE's customers.

- Raver 500/230 kV Transformer, in service 2017

This project enables new capacity on the North of Echo Lake flowgate, increasing reliability to Puget Sound area loads and decreasing potential congestion experienced in heavy winter and light spring loading periods. This project is also important because it could make new capacity available for PSE requests for transmission service from eastside generation alternatives to PSE loads.

2 / PSE's current Attachment K document is publicly available at http://www.oasis.oati.com/PSEI/PSEIdocs/PSE_Plan_2014_Final.pdf.

REGIONAL TRANSMISSION EFFORTS

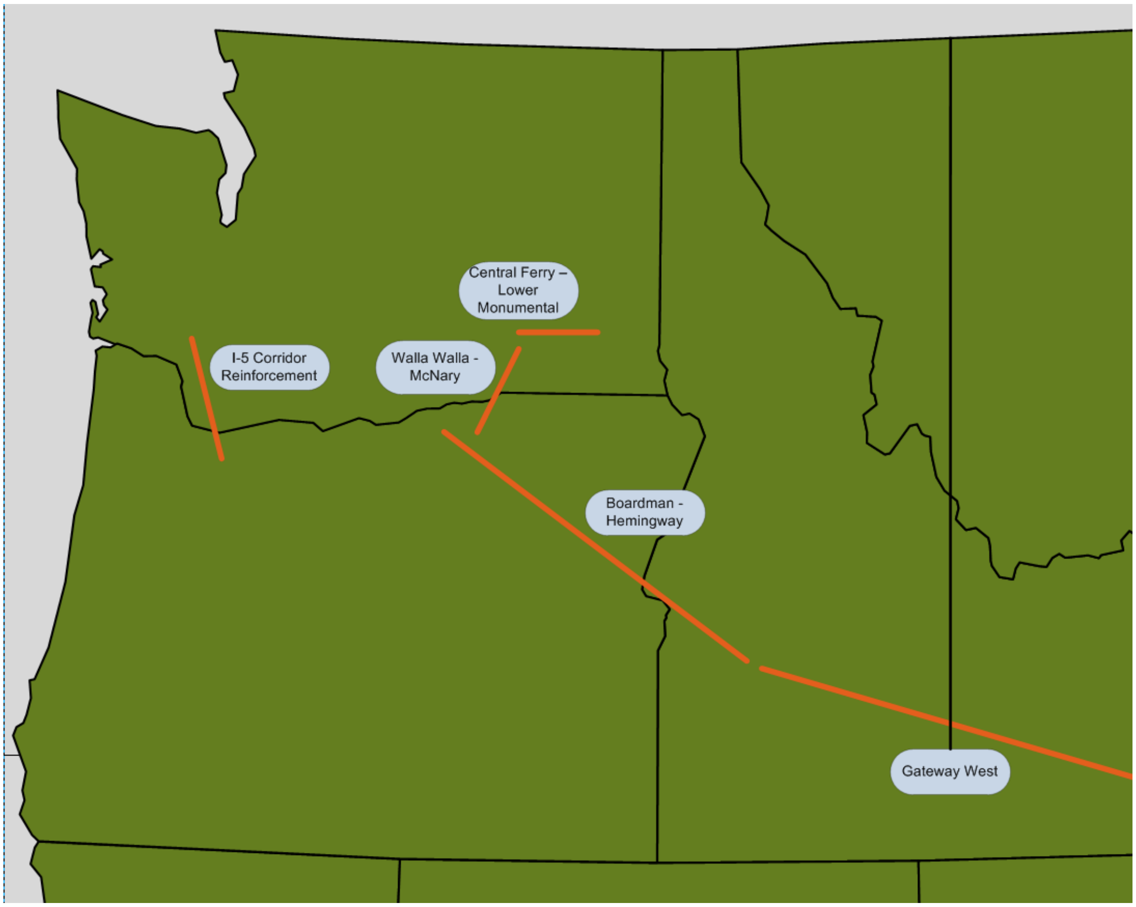
Major Proposed Projects

Several major transmission projects are proposed for the Pacific Northwest. These projects may impact each other as well as existing Western Electricity Coordinating Council (WECC) paths. The WECC maintains a public transmission project database where project sponsors can post information and updates for their projects. The projects listed below can be found in the WECC database or at BPA's website. All are assumed to have some effect on the paths and flowgates that PSE uses to transmit energy from remote resources to load. Project names are followed by expected cost, completion date and current status.

- PacifiCorp's Gateway West: ~ $2.7 billion, tentative completion date 2020 – 2024
- Idaho Power's Boardman to Hemingway: ~ $900 million, tentative completion date 2020
- BPA's Central Ferry – Lower Monumental Project: ~ $90 million, tentative completion date 2015
- BPA's I-5 Corridor Reinforcement: ~ $340 million, tentative completion date 2021
- PacifiCorp's Walla Walla – McNary 230 kV: cost unknown, tentative completion date 2017

These projects are displayed in Figure I-3. For a complete listing of WECC projects, see https://www.wecc.biz/TransmissionExpansionPlanning/Pages/Project-Information-Portal2.aspx.

Figure I-3: Proposed Regional Transmission Projects



These projects bring three main benefits to the region:

1. access to significant incremental renewable resources in the northwestern states,
2. improvement in regional transmission reliability, and
3. new market opportunities for dealing with participants outside of the region.

ColumbiaGrid Efforts

ColumbiaGrid is a non-profit membership corporation formed in 2006 to improve the operational efficiency, reliability and planned expansion of the Pacific Northwest's transmission grid. While ColumbiaGrid does not own transmission, PSE, other members and additional parties to ColumbiaGrid's agreements do own and operate an extensive network of transmission facilities. ColumbiaGrid's members are PSE, Avista, BPA, Chelan County PUD, Grant County PUD, Seattle City Light, Snohomish PUD and Tacoma Power.

ColumbiaGrid has substantial responsibilities for transmission planning, reliability, OASIS and other development services. These tasks are defined and funded through a series of "Functional Agreements" with members and other participants. Development of these agreements is carried out in a public process with broad participation. ColumbiaGrid's transparent processes encourage broad participation and interaction with stakeholders, including customers, transmission providers, states and tribes. It also provides a non-discriminatory forum for interested parties to receive and present pertinent information concerning the regional interconnected transmission system.

Planning and Expansion. ColumbiaGrid's planning and expansion efforts are intended to promote single-utility planning and expansion of the regional grid. The Planning and Expansion Functional Agreement (PEFA), which has been signed by all of ColumbiaGrid's members and three non-member participants (Cowlitz County PUD, Douglas County PUD and Enbridge, Inc.), defines the obligations under this program.

The PEFA charges ColumbiaGrid with answering three key questions concerning the transmission network: what should be built, who should build it and who should pay for it. ColumbiaGrid provides a number of services in this planning program, including performing annual transmission adequacy assessments, producing a Biennial Transmission Plan and identifying transmission needs. ColumbiaGrid also facilitates a coordinated planning process for the development of multi-party transmission system projects.

ColumbiaGrid's 2014 System Assessment serves as an input to the 2015 Biennial Transmission Expansion Plan. The Assessment highlights areas of the system that may be vulnerable to deficiencies in meeting reliability standards.[3] In support of the Biennial Plan, PSE participated in three study teams addressing specific regions: the Puget Sound Area Study Team (PSAST), the Wind Integration Study Team (WIST) and the Cross Cascades North Study Team.

3 / The referenced plans and assessments can be found on ColumbiaGrid's web site at http://www.columbiagrid.org/documents-search.cfm by using the document search function.

Puget Sound Area Study Team (PSAST). The ColumbiaGrid PSAST published its "Transmission Expansion Plan for the Puget Sound Area" in October 2010; an update was issued in October 2011. Since then, area utilities have continued to meet and develop additional scenarios to study. Six projects have been identified as being the most effective at reducing risk of curtailing firm transfers for south-to-north congestion on the North of Echo Lake flowgate.

1. Reconductor the Bothell – SnoKing 230 kV double circuit line.
2. Add series inductors to the Massachusetts – Union – Broad and Broad – East Pine 115 kV underground cables.
3. Extend the Northern Intertie Remedial Action Scheme (RAS) to compensate for the combined loss of Monroe – SnoKing – Echo Lake and Chief Joseph – Monroe 500 kV lines.
4. Add a Raver 500/230 kV transformer and a 230 kV Raver – Covington line.
5. Upgrade both Sammamish – Lakeside – Talbot 115 kV lines to 230 kV. Energize one line at 230 kV and the other at 115 kV. (This is part of PSE's Energize Eastside project.)
6. Reconductor the Duwamish – Delridge 230 kV line.

PSAST has also updated the north-to-south portion of the "Transmission Expansion Plan for the Puget Sound Area." Two projects were identified to be the most effective at correcting major limitations for north-to-south transfers in the Puget Sound area.

- Add a second Portal Way 230/115 kV transformer.
- Upgrade Monroe – Novelty 230 kV line to operate at 80 degrees Celsius.

Wind Integration Study Team (WIST). WIST was formed by the Northern Tier Transmission Group (NTTG) and ColumbiaGrid to facilitate the integration of renewable generation into the Northwest transmission grid. Its current focus is to study and address system constraints related to increased use of dynamic transfers for variable energy resources. The study team produced a set of reports in 2011 that confirmed the need for dynamic transfer capability limits, explored dynamic transfer capability study methodologies and applied the methodology to several NW paths. Work continued through 2012 to quantify the dynamic transfer capability of NW paths and to help identify other dynamic transfer impacts on reliability.

While the Dynamic Transfer Capability Task Force is not currently meeting on a regular basis, ColumbiaGrid facilitated a Dynamic Transfer Capability study on the California – Oregon Intertie (COI) in late 2014 under a separate request by BPA.

Cross Cascades North Study Team. The Cross Cascades North Study Team is currently investigating the extent of system problems on the Cross Cascades North flowgate. It is also evaluating the performance and interaction of various potential transmission projects. As discussed previously, this path delivers remote resources from east of the Cascade Mountains to westside load areas. Should increasing amounts of eastside remote renewable generation displace westside thermal generation, the path may exceed its system operating limits and cause critical outages.

To address these issues, the team studied the incremental transfer capability benefits of potential system expansion alternatives. Alternatives were categorized as short lead-time construction or long lead-time construction. These studies showed that the most beneficial short lead-time alternative was the addition of series capacitors at the Schultz Switching Station on the Raver #3 and Raver #4 lines; the most beneficial long lead-time alternative was a new 500 kV transmission line between the Chief Joseph and Monroe substations. Long lead-time construction is assumed to take at least 10 years.

Order 1000

The Federal Energy Regulatory Commission's Order 1000 requires transmission providers to:

- participate in a transmission planning process that evaluates alternatives that may resolve the region's transmission needs in a more cost-effective and efficient manner than local planning processes;
- have a methodology for cost allocation for such projects within the region; and
- consider public policy requirements in its planning process.

The Order further requires transmission providers to improve coordination across regional transmission planning processes by developing and implementing procedures for joint evaluation and sharing of information regarding both regional transmission needs as well as potential interregional transmission facilities. The Order also requires regions to have a common methodology for allocating costs of interregional projects.

PSE recognizes ColumbiaGrid as its regional planning entity. The ColumbiaGrid PEFA addresses many of the Order 1000 requirements for PSE, but an additional Order 1000 Functional Agreement has been created to address incremental changes to the PEFA planning process to ensure that it complies with regional planning requirements.

The Order 1000 Functional Agreement and corresponding changes to the Attachment K to PSE's OATT were filed with FERC on December 18, 2013 in response to FERC's June 20, 2013 Order regarding PSE's original compliance filing of October 11, 2012. On September 18, 2014, FERC issued an Order largely accepting the Order 1000 Functional Agreement filing with some additional modifications. A third compliance filing that addressed those modifications was made on November 17, 2014.

For the interregional portion of the order, PSE worked with ColumbiaGrid and the other regions in the western interconnection (the California Independent System Operator [CAISO], WestConnect and the Northern Tier Transmission Group) to develop the required common language for interregional coordination and cost allocation; this was filed with FERC on June 19, 2013. FERC issued an Order generally accepting the interregional language on December 18, 2014. While no further changes to the Order 1000 Functional Agreement or PSE's Attachment K are anticipated, a filing will be made with FERC by February 18, 2015 to address changes being made by the CAISO in response to the FERC's Interregional Order. PSE and ColumbiaGrid will implement the Order 1000 Agreement beginning with the 2015 ColumbiaGrid planning cycle.

Information regarding Order 1000 is available on the ColumbiaGrid website under Order 1000 at https://www.columbiagrid.org/1000-overview.cfm.

What is CAISO?

The California Independent System Operator (**CAISO**) is an independent, non-profit Independent System Operator (ISO), serving California. The **CAISO** oversees the operation of California's bulk electric power system, transmission lines, and electricity market generated and transmitted by its member utilities.

OUTLOOK AND STRATEGY

PSE needs to advocate and participate in local and regional transmission projects that relieve congestion, increase transfer capacity and improve reliability for its electric customers. This can be accomplished through the following actions.

Participate in efforts focusing on relieving existing and future transmission congestion.

PSE should continue to participate in the planning of regional transmission projects that decrease congestion and curtailment risk, increase regional reliability, and help maintain low power prices for its customers. PSE will pursue these opportunities through various forums, including ColumbiaGrid, BPA Network Open Season and Attachment K, and through its utility partners in the Puget Sound area. Because of our geographical location, PSE will focus on efforts to study and develop projects that relieve congestion on the West of Cascades North, North of Echo Lake and Raver – Paul flowgates.

Refine assessment of future internal transmission constraints related to westside generation alternatives.

PSE has begun to lay out the methodology for determining which internal transmission constraints may interfere with bringing new westside resource options to load. To the extent that PSE acquires incremental westside generation in the future, we will need to determine the quantitative and qualitative constraints involved in bringing that resource to load.

Identify opportunities to obtain additional transmission capacity necessary to deliver energy from eastside generation alternatives.

If PSE identifies cost-effective resources located east of the Cascades, we need to consider the means to build or acquire additional transmission service from those remote resources. PSE should continue to assess the quantitative and qualitative strengths and weaknesses of taking additional transmission service (through a BPA NOS process) or obtaining physical transmission capacity. PSE should continue to participate in ColumbiaGrid study groups that seek to refine which West of Cascades North transmission project is most beneficial to the region.

DEMAND-SIDE RESOURCES

Contents

To develop an integrated resource plan, PSE evaluates demand-side resources together with supply-side resources to develop a capacity expansion forecast. Demand-side resources include energy efficiency, fuel conversion, distributed generation, distribution efficiency, generation efficiency and demand-response. This appendix contains the final report on the assessment conducted by Cadmus for PSE to determine the quantity and cost for each of these resource types. The results of this assessment are inputs into the electric and gas portfolio analysis, where the optimal cost-effective amount of demand-side resources is determined.

The Cadmus ***Comprehensive Assessment of Demand-side Resource Potentials (2016-2015)*** *can be accessed and downloaded from the 2015 IRP links within PSE's website at:*

http://pse.com/aboutpse/EnergySupply/Pages/Resource-Planning.aspx.

Comprehensive Assessment of Demand-Side Resource Potentials (2016-2035)

November 1, 2015

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Acronyms

AFUE	Annual fuel utilization efficiency
AMI	advanced meter infrastructure
BPA	Bonneville Power Administration
C&I	Commercial and industrial
CALMAC	California Measurement Advisory Council
CPECS	Commercial Buildings Energy Consumption Survey
CBSA	Commercial Building Stock Assessment
CHP	Combined heat and power
CPP	Critical peak pricing
CRP	Cost Recovery Program
DEER	Database of Energy Efficiency Resources
DHW	Domestic hot water
DLC	Direct load control
DOE	U.S. Department of Energy
DSM	Demand-side management
DSR	Demand-side resources
EIA	Energy Information Administration
EISA	Energy Independence and Security Act
EM&V	Evaluation, measurement, and verification
EUL	Expected useful life
FERC	Federal Energy Regulatory Commission
FTE	Full-time equivalent
GWh	Gigawatt-hours
IHD	In-home display
IOU	Investor-owned utility
IREC	Interstate Renewable Energy Council
IRP	Integrated resource planning
ITC	Investment tax credit
LCOE	Levelized cost of energy
NEEA	Northwest Energy Efficiency Alliance
O&M	Operations and maintenance
OG&E	Oklahoma Gas & Electric
OPALCO	Orcas Power and Light Cooperative
PCT	Programmable communicating thermostat
PV	Photovoltaic
RCS	Residential characteristic survey
RTF	Regional Technical Forum
RTU	Rooftop unit
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric
SEEM	Simple Energy Enthalpy Model

SMUD	Sacramento Municipal Utility District
T&D	Transmission and distribution
TOU	Time of use
TRC	Total resource cost
UEC	Unit energy consumption
VAV	Variable air volume
Wp	Peak watts
WSEC	Washington State Energy Code

Executive Summary

Overview

This report presents the results of an independent assessment of the technical and achievable potential for electric and natural gas demand-side resources (DSR) in the service territory of Puget Sound Energy (PSE) over the 20-year planning horizon, from 2016 to 2035. PSE commissioned this assessment as part of its biennial integrated resource planning (IRP) process.

Building upon PSE's 2014–2033 assessment of DSR resources, this assessment incorporates PSE's programmatic accomplishments in the intervening years. Further, it presents updates of baseline and DSR data from primary and secondary sources and is informed by the work of other entities in the region, such as the Northwest Power and Conservation Council (the Council), the Northwest Regional Technical Forum (RTF), and the Northwest Energy Efficiency Alliance (NEEA). The methods used to evaluate the technical and achievable technical potential draw upon best utility industry practices and remain consistent with the methodology used by the Council in its assessment of regional conservation potentials in the Sixth Northwest Conservation and Electric Power Plan (Sixth Plan).

Summary of Results

Table 1 presents the technical and achievable technical potentials identified in this study. As shown, electric DSRs account for 706 aMW and 1,394 winter peak MW of achievable technical potential by 2035. These potentials represent 22% of retail energy sales and 20% of winter peak demand.[1] Similarly, achievable technical natural gas potential accounts for 17% of forecasted 2035 retail sales. High-level potentials by resource follow this summary table, and more detailed results are presented in the body of this report.

All values are reported at generator and assume line loss of 6.9% for electric resources and 0.8% for gas resources. In addition, the numbers discussed in this report do not account for intra-year ramping. DSR bundles used as input into PSE's IRP analysis do reflect intra-year ramping, as discussed in the General Approach and Methodology section, under About Hourly DSR Estimates.

[1] Demand response potentials do not account for program interactions; thus, this potential would likely be reduced if multiple programs were competing for participants.

Table 1. Summary of Energy and Capacity Saving Potentials, Cumulative in 2035

	Energy (aMW/Million Therms)		Winter Coincident Peak Capacity (MW)	
Resource	**Technical Potential**	**Achievable Technical Potential**	**Technical Potential**	**Achievable Technical Potential**
Electric Resources				
Energy Efficiency	781	622	1,218	970
Fuel Conversion	222	61	630	141
Demand Response	N/A	N/A	N/A	263
Distributed Generation	N/A	22	N/A	20
Electric Resources Total	**1003**	**706**	**1,848**	**1,394**
Natural Gas Resources				
Energy Efficiency	331	225	N/A	N/A

Energy Efficiency

Table 2 shows 2035 forecasted baseline electric sales and potential by sector. Study results indicate 781 aMW of technically feasible electric energy efficiency potential will be available by 2035, the end of the 20-year planning horizon. Upon taking market constraints into account, this translates to an achievable technical potential of 622 aMW. Provided that all of this potential proves cost-effective and realizable, it will result in a 20% reduction in 2035 forecast retail sales.

Consistent with the Council's method, this study assumes that 85% of electric resources will be achievable over time. However, due to the timing of lost opportunity resource acquisition, achievable technical potential is less than 85% of technical potential (described in greater detail in General Approach and Methodology).

Table 2. Electric Energy-Efficiency Potential by Sector, Cumulative in 2035

		Technical Potential		Achievable Technical Potential	
Sector	**2035 Baseline Sales (aMW)***	**aMW**	**Percentage of Baseline Sales**	**aMW**	**Percentage of Baseline Sales**
Residential	1,616	390	24%	304	19%
Commercial	1,409	360	26%	293	21%
Industrial	129	30	23%	26	20%
Total	**3,154**	**781**	**25%**	**622**	**20%**

* These baseline sales values are the post-standards, calibrated forecasts.

Table 3 shows 2035 forecasted baseline natural gas sales and potential by sector. Study results indicate roughly 331 million therms of technically feasible natural gas energy efficiency potential by 2035, translating to an achievable technical potential of 225 million therms. If all of this potential proves cost-effective and realizable, it will result in a 17% reduction in 2035 forecasted retail sales.

Table 3. Natural Gas Energy-Efficiency Potential by Sector, Cumulative in 2035

Sector	2035 Baseline Sales (Million Therms)	Technical Potential		Achievable Technical Potential	
		Million Therms	As Percent of Baseline	Million Therms	As Percent of Baseline
Residential	844	217	26%	140	17%
Commercial	440	108	25%	81	18%
Industrial	23	6	27%	5	20%
Total	**1,307**	**331**	**25%**	**225**	**17%**

Comparison to 2013 IRP

This energy efficiency potential assessment largely updates the analysis conducted for PSE's 2013 IRP. However, a number of differences between this assessment and the 2013 IRP have led to differences in technical and, thus, achievable technical potential. These differences are:

- Utilization of PSE's most recent energy and sales forecasts
- Incorporation of assumptions, data, and new measures from the RTF
- Adjustments to remaining potential, based on PSE's actual 2012–2013 and projected 2014–2015 energy efficiency program accomplishments
- Updated data on measure costs, savings, lifetime, and applicability
- Adjustments to end use equipment saturation, efficiency share, technical feasibility, and percent incomplete values resulting from the incorporation of PSE-specific data from NEEA's Residential Stock Building Assessment (RBSA)
- Incorporation of new codes and standards
- Use of Simple Energy and Enthalpy Model (SEEM) 94 building simulations[2]

Table 4 compares electric and natural gas technical potentials of the two studies by sector. At an aggregate level, the 2015 study indicates an electric technical potential that is approximately 9% (67 aMW) higher than the 2013 IRP (781 aMW in the 2015 IRP versus 714 aMW in the 2013 IRP).

Table 4. Comparison of Energy-Efficiency Technical Potential, 2013 IRP to 2015 IRP

	Electric (aMW)		Natural Gas (Million Therms)	
Sector	2013 IRP	2015 IRP	2013 IRP	2015 IRP
Residential	356	390	226	217
Commercial	331	360	120	108
Industrial	28	30	4	6

[2] Regional Technical Forum. "Simplified Energy Enthalpy Model." Available online at: http://www.nwcouncil.org/energy/rtf/measures/support/SEEM/Default.asp. SEEM94 was the most recent version at the time of analysis of potentials.

Total	**714**	**781**	**350**	**331**

The following four factors largely drive this increase in electric energy efficiency technical potential, listed in order of their absolute magnitude:

1. Commercial lighting potential increased by 31% from 131 aMW to 171 aMW. The increase in potential for this end use is due to the inclusion of linear LED tubes in standard and high bay applications in the 2015 IRP that were not included in the 2013 IRP.
2. Residential water heating potential increased 26% from 95 aMW to 119 aMW. The measures primarily comprising this total are:
   - Heat Pump Water Heater – RTF Tier 2 (52 aMW)
   - Solar Hot Water Heater (17 aMW)
   - Heat Pump Water Heater – RTF Tier 1
   - Low-Flow Showerheads (10 aMW)

   The increase in potential for this end use is primarily driven by two factors:
   - The RBSA indicates a lower saturation of efficient electric hot water heaters than previously assumed.
   - The fuel share of electric water heaters among PSE's electric single-family customers was increased from 34% to 41%.based on RBSA results.
3. Residential lighting potential increased 41% from 43 aMW to 60 aMW. This change is primarily caused by the shift in technical potential from CFLs to LEDs as the market for LEDs has matured due to availability of more affordable lamp options since the 2013 IRP. In addition, the RBSA has provided us with data to update assumptions about the relative share of standard versus specialty lamps. As the relative share of specialty lamps has increased from 13% to 38% for single-family homes since the 2013 IRP update, so too has the lighting potential, since these lamps are mostly exempt from the 2007 Energy Independence and Security Act (EISA) standards that affect the standard lamp baselines.
4. Residential appliance potential has increased 19% from 56 aMW to 67 aMW. This change is primarily due to the inclusion of a new measure—heat pump dryers. This new measure contributes an additional 16 aMW to the increase in technical potential.

The study indicates lower natural gas technical potential (331 MM therms versus 350 MM therms). As illustrated in Table 4 above, potential has decreased by roughly 9 MM therms in the residential sector and 12 MM therms in the commercial sector. These differences are primarily due to the reduction in potential as a result of PSE programmatic achievements in 2012-2013 and anticipated 2014-2015 savings.

Fuel Conversion

The fuel conversion analysis estimates available potential from converting electric equipment to natural gas for two main groups in PSE's natural gas service territory—customers who do not currently have natural gas service and customers who do have natural gas service but retain electric equipment (e.g., water heaters or appliances) that could be converted to natural gas. Table 5 shows the available technical and achievable technical potential in 2035 for each customer type.

Table 5. Summary of Fuel Conversion Potentials, Cumulative in 2035

	Technical Potential		Achievable Technical Potential	
Customer Type	**Electric Savings (aMW)**	**Additional Gas Usage (million therms)**	**Electric Savings (aMW)**	**Additional Gas Usage (million therms)**
Electric - Only	159	11	45	4
Existing Gas Customer	63	4	16	1
Total	**222**	**15**	**61**	**5**

Based upon the results of a survey in support of the 2009 IRP, the maximum percent achievable for fuel conversion is assumed to be 63%. Furthermore, based on the results of the survey and previous PSE experience, it is assumed, within the residential sector, of the new gas customers that convert a space heater, 70% will also convert a water heater, and 5% will convert a range and/or dryer. For existing gas customers, all will convert a water heater, and 5% will convert a range and/or dryer. Similar percentages are assumed for the water heating conversions in the commercial sector.

Comparison to 2013 IRP

As with energy efficiency, this analysis largely updates the 2013 IRP. The analysis builds upon the same revised data cited above, including baseline data, PSE's sales and customer forecasts, and measure assumptions. Table 6 compares estimated technical and achievable technical potential with the 2013 IRP. This study indicates a decrease in technical and achievable technical potential.

Table 6. Comparison of Fuel Conversion Potential, 2013 IRP to 2015 IRP

	Technical Potential (aMW)		Achievable Technical Potential (aMW)	
Customer Type	**2013 IRP**	**2015 IRP**	**2013 IRP**	**2015 IRP**
Electric-Only	165	159	45	45
Existing Gas Customer	75	63	16	16
Total	**240**	**222**	**62**	**61**

Demand Response

Table 7 presents estimated winter resource potentials for all demand response resources for the residential, commercial, and industrial sectors. The total market potential available in the winter is 181 MW, equating to 4.5% of winter peak.

Table 7. Demand Response Market Technical Potential, MW in 2035

Sector	Winter Market Potential (MW)	Percent of System Peak - Winter
Residential	115	2.9%

Sector	Winter Market Potential (MW)	Percent of System Peak - Winter
Commercial	62	1.6%
Industrial	5	0.1%
Total	**181**	**4.5%**

Comparison to 2013 IRP

This study focuses on the same program strategies as the 2013 IRP. By sector, Table 8 compares estimated market potential during peak periods.

Table 8. Comparison of Demand Response Achievable Technical Potential, 2013 IRP to 2015 IRP

Sector	Winter (MW) 2013 IRP	Winter (MW) 2015 IRP
Residential	130	115
Commercial	78	62
Industrial	4	5
Total	**213**	**181**

The results of the two studies exhibit the largest differences in the residential sector and commercial sectors, where potentials have decreased relative to the 2013 IRP. These differences result from decreases in overall potential achieved through the residential DLC programs (which have been based on the pilot program PSE implemented from 2009 through 2011) and commercial curtailment.

Distributed Generation

With the exception of solar photovoltaic (PV), this study does not estimate distributed generation potentials; rather, it updates costs for individual distributed generation technologies and incorporates these in the 2015 IRP. For detailed potentials from the 2015 IRP analysis, see Cadmus' 2008 report.[3]

Comparison to the Sixth Plan

This study employed methodologies consistent with the Sixth Plan to estimate available energy efficiency potential (see Appendix A for a detailed comparison of methodologies). Additionally, Cadmus conducted a thorough review of the baseline and measure assumptions used by the Council, including costs, savings, applicability, and current saturations. Although this study relied on data specific to PSE's service territory whenever possible, where appropriate, it incorporated Council assumptions.

3 http://www.pse.com/SiteCollectionDocuments/2009IRP/AppL1_IRP09.pdf.

By applying PSE's share of regional sales, by sector, to the Council's regional potential, one can estimate the Sixth Plan's share of potential in PSE's service territory. However, a number of factors must be considered in comparing that allocated potential to this study's results:

- The Council, by necessity, relied on average regional data whereas this study used primary data from PSE's service territory. Therefore, allocating regional potential based on sales may not account for PSE's unique service territory characteristics (such as customer mix, use per customer, end-use saturations, fuel shares, and current measure saturations). Similarly, some industries included in the Sixth Plan may not exist in PSE's service territory.
- PSE and the Council relied on unique baseline energy forecasts, each of which served as a major driver in the respective potential estimates.
- Both studies assessed potential over a 20-year period; however, the Sixth Plan began in 2010, while this study's estimation of potential began in 2016.
- Due to the timing of the Sixth Plan's release, not all upcoming codes and standards were removed from the potential (most notably, new standards relating to commercial lighting and residential water heating, as described in General Approach and Methodology).
- The Sixth Plan, completed in 2010, used data sources current at that time. In addition to using the PSE-specific data noted above, this study used more current data, particularly for measure costs.

Incorporation of DSR into PSE's IRP

The achievable technical potentials shown above have been grouped by the levelized cost of conserved energy for inclusion in PSE's IRP model. These costs have been calculated over a 20-year program life; the General Approach and Methodology section provides additional detail on the levelized cost methodology. Bundling resources into a number of distinct cost groups allows the model to select the optimal amount of annual DSR, based on expected load growth, energy prices, and other factors.

Cadmus spread the annual savings estimates over 8,760 hour load shapes to produce hourly DSR bundles for electric energy efficiency resources and monthly load shapes for gas. In addition, we assumed savings are gradually acquired over the year, as opposed to instantly on the first day of January. PSE provided intra-year DSR acquisition schedules, which we used to ramp hourly savings across months. See About Hourly DSR Estimates in the General Approach and Methodology section for additional detail.

Figure 1 shows the annual cumulative combined potential for energy efficiency, fuel conversion, and distributed generation by each cost bundle considered in PSE's 2015 IRP. Figure 2 shows electric achievable potential by resource type. Figure 3 shows annual DSR bundles for natural gas energy efficiency.

Figure 1. Annual Electric DSR Bundles by Cost Group

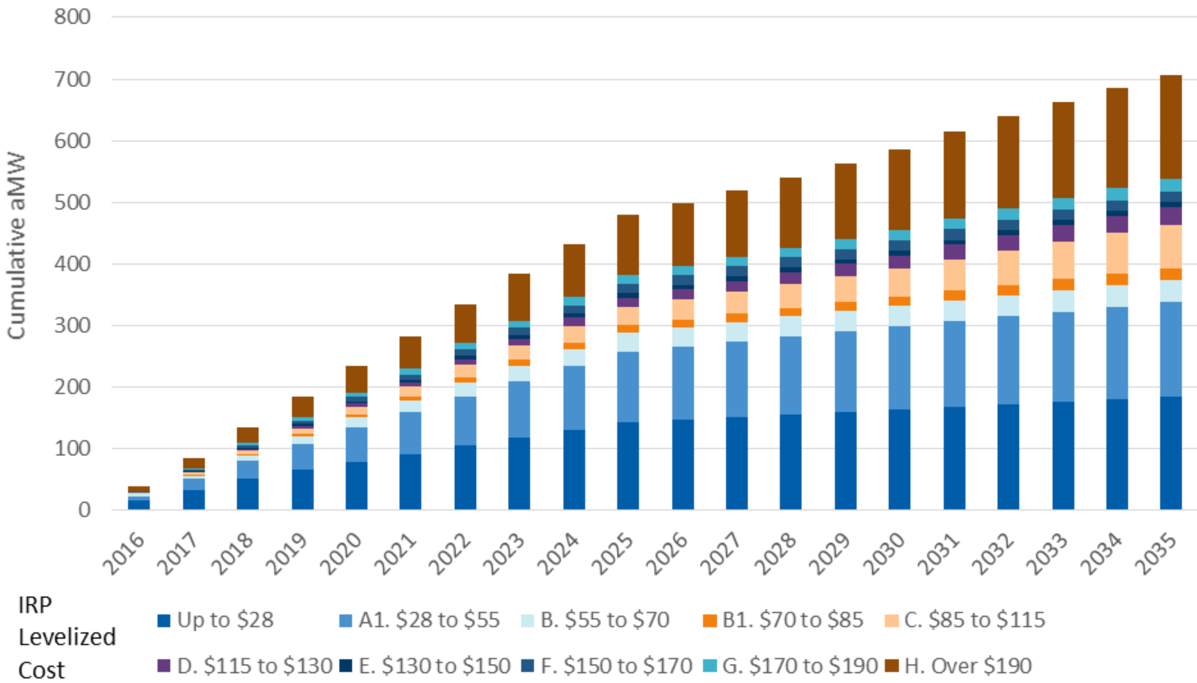


Figure 2. Electric Achievable Potential by Resource Type

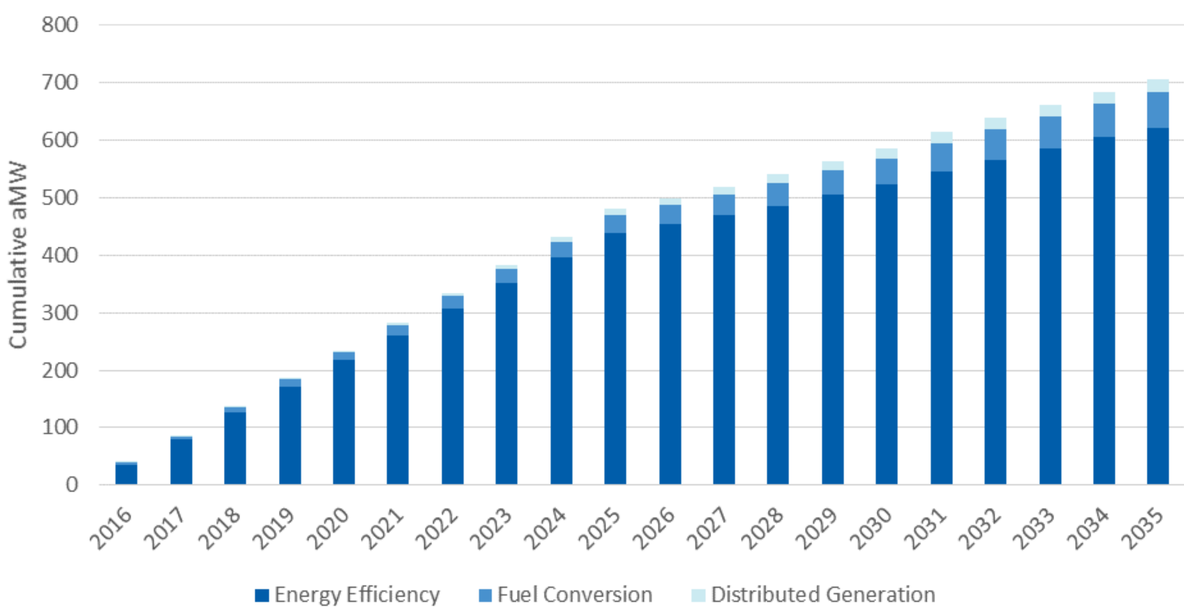
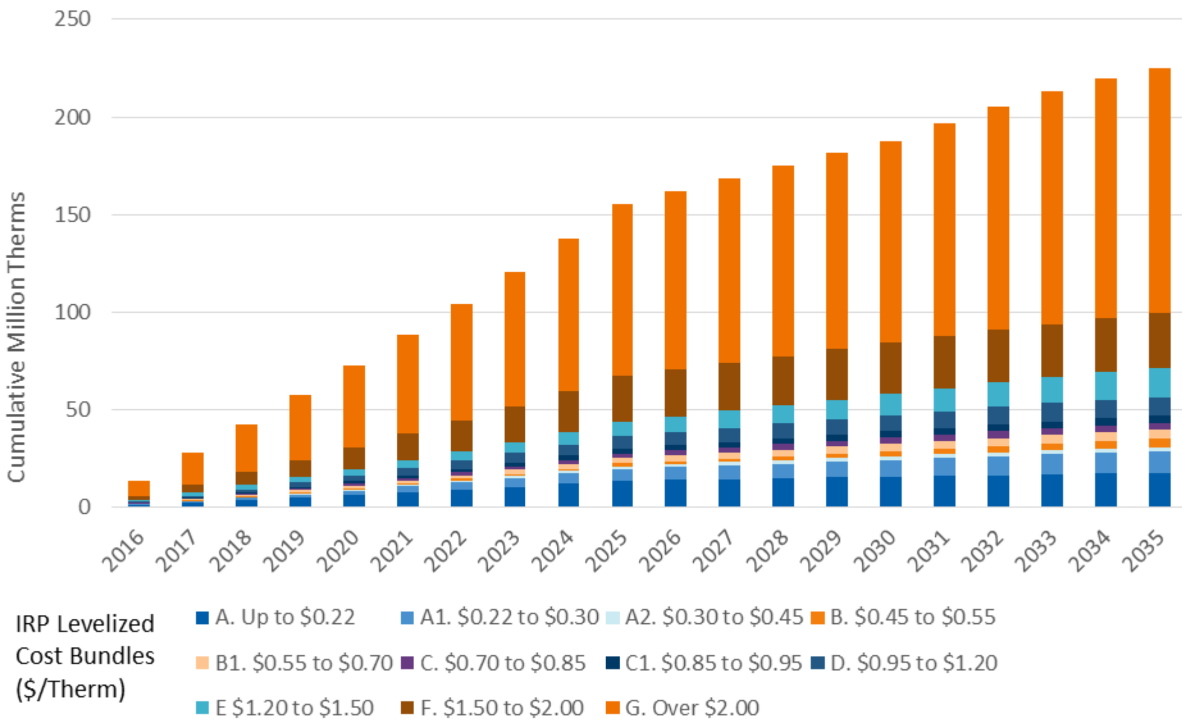


Figure 3. Annual Natural Gas DSR Bundles by Cost Group



In addition to the energy efficiency, fuel conversion, and distributed generation bundles shown above, PSE includes three other resource bundles in its IRP:

- The expected effects of codes and standards (including EISA and U.S. Department of Energy [DOE] standards). PSE includes "standards" bundles in both gas and electric IRP models.
- Capacity-only impacts of demand response.
- Savings associated with distribution efficiency improvements (which fall outside the scope of this study).

Organization of the Report

The body of this report has been organized in four sections. The first describes the general methodology for assessing potential used for each resource type; the remaining three sections present the key assumptions and results for each resource. The document's appendices present additional technical information and descriptions of data used and their sources.

General Approach and Methodology

This report describes the technologies, data inputs, data sources, data collection processes, and assumptions used in calculating technical and achievable technical long-term potentials.

General Approach

The demand-side resources (DSR) analyzed in this study differ with respect to technology, availability, types of load impact, and target consumer markets. Analysis of their potentials, therefore, requires using customized methods to address the unique characteristics of each resource. These methods, however, spring from the same conceptual framework and seek to achieve estimates of two distinct types of potential—technical and achievable technical, which are defined here:

- ***Technical potential*** assumes that all technically feasible resource opportunities may be captured, regardless of their costs or other market barriers. Notably, the concept of technical potentials proves less relevant to some resources, such as demand response since, from a strictly technical point of view, nearly all end-use loads may be subject to interruption or displacement by on-site generation.
- ***Achievable technical*** potential is defined as the portion of technical potential that might be assumed achievable in the course of the planning horizon, regardless of the acquisition mechanism. (For example, savings may be acquired through utility programs, improved codes and standards, or market transformation.)

In addition to the quantity of available potential, the timing of resource availability presents a key consideration. For this analysis, resources can be split into two distinct categories:

- ***Discretionary resources*** are retrofit opportunities in existing facilities that, theoretically, remain available at any point over the course of the study period.
- ***Lost opportunity resources*** have pre-determined availability, such as replacements after equipment failure and opportunities in new construction.

About Levelized Costs

Identified potential is grouped by levelized cost over the 20-year study horizon, allowing the Puget Sound Energy (PSE) integrated resource planning (IRP) model to pick the optimal DSR amount, given various assumptions regarding future resource requirements and costs. The 20-year levelized cost calculation incorporates numerous factors, which are consistent with the Northwest Power and Conservation Council (the Council) methodology and shown in Table 9.

Table 9. Levelized Cost Components

Type	Component
Costs	Incremental Measure Cost
	Incremental O&M Cost*
	Administrative Adder
Benefits	PV of Non-Energy Benefits
	Present Value of T&D Deferrals
	Conservation Credit
	Secondary Energy Benefits

*Some measures may have a reduction in O&M costs, which is effectively treated as a benefit in the levelized cost calculation.

In addition to the upfront capital cost and annual energy savings, the levelized cost calculation incorporates several other factors, consistent with the Council's methodology:

- ***Incremental Measure Cost.*** This study considers the costs required to sustain savings over a 20-year horizon, including reinstallation costs for measures with useful lives less than 20 years. If a measure's useful life extends beyond the end of the 20-year study, Cadmus incorporates an end effect that treats the levelized cost of that measure over its useful life (EUL)[4] as an annual reinstallation cost for the remainder of the 20-year period.[5]

  For example, Figure 4 shows the timing of initial and reinstallation costs for a measure with an eight-year lifetime in context with the 20-year study. The measure's final lifetime in this study ends after the study horizon, so the final four years (Year 17 through Year 20) are treated differently by levelizing measure costs over its eight-year useful life and treating these as annual reinstallation costs.

Figure 4. Illustration of Capital and Reinstallation Cost Treatment

	Year																			
Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial Capital Cost																				
Re-installation Cost																	End Effect			

- ***Incremental operations and maintenance (O&M) costs or benefits.*** As with incremental measure costs, O&M costs are considered annually over the 20-year horizon. The present value is used to adjust the levelized cost upward for measures with costs above baseline technologies and downward for measures that decrease O&M costs.

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4 This refers to levelizing over the measure's useful life, equivalent to spreading incremental measure costs over its EUL in equal payments assuming a discount rate of PSE's weighted average cost of capital.

5 This method is applied both to measures with a useful life of greater than 20 years and those with a useful life that extends beyond the twentieth year at the time of reinstallation.

- ***Administrative adder.*** Cadmus assumed a program administrative cost equal to 20% of incremental measure costs for electric measures across all sectors. For gas measures, Cadmus assumed program administrative costs of 15% in the residential sector and 25% for the commercial and industrial (C&I) sectors.
- ***Non-energy benefits*** are treated as a reduction in levelized costs for measures that save resources, such as water or detergent. For example, the value of reduced water consumption due to the installation of a low-flow showerhead reduces the levelized cost of that measure.
- ***The regional 10% conservation credit, capacity benefits during PSE's system peak, and transmission and distribution (T&D) deferrals*** are similarly treated as reductions in levelized cost for electric measures. The addition of this credit per the Northwest Power Act is consistent with Council methodology and is effectively an adder to account for unquantified external benefits of conservation when compared to other resources.[6] In th2 2015 IRP the 10% conservation credit was applied to the gas measures as well.
- ***Secondary energy benefits*** are treated as a reduction in levelized costs for measures that save energy on secondary fuels. This treatment is necessitated by Cadmus' end-use approach to estimating technical potential. For example, consider the cost for of R-60 ceiling insulation for a home with a gas furnace and an electric cooling system. For the gas furnace end use, Cadmus considers energy savings that R-60 insulation produces for electric cooling systems, conditioned on the presence of a gas furnace, as a secondary benefit that reduces the levelized cost of the measure. This adjustment impacts only the measure's levelized costs; the magnitude of energy savings for the R-60 measure on the gas supply curve is not impacted by considering secondary energy benefits.

Data Sources

The full assessment of resource potential required the compilation of a large set of measure-specific technical, economic, and market data obtained from secondary sources and through primary research. The study's main data sources included:

- ***PSE internal data.*** These encompass historical and projected sales and customers, hourly load profiles, and historic and projected DSR accomplishments.
- ***Primary data.*** This study relied on several data sources specific to PSE's service territory and customers, including the Northwest Energy Efficiency Alliance (NEEA) 2011 Residential Building

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6 Northwest Power & Conservation Council. "Northwest Power Act." Available online: http://www.nwcouncil.org/library/poweract/default.htm.

Stock Assessment (RBSA), 2010 Residential Characteristic Survey, 2008 Fuel Conversion Survey, and the NEEA 2007 Commercial Building Stock Assessment (CBSA).[7]

- ***Secondary Pacific Northwest sources*.** Several Northwest entities provided data critical to this study, including the Council, the Regional Technical Forum (RTF), and NEEA. Information derived from these sources included technical information on measure savings, costs, and lives; hourly end-use load shapes (to supplement building simulations described above); and commercial building and energy characteristics.
- ***Building Simulations:*** This study required building simulations (using the Simple Energy Enthalpy Model [SEEM]) for the residential sector, with separate models created for each customer segment, and construction vintage.[8]
- ***Additional Secondary Sources.*** The study relied on a number of secondary sources to characterize measures, assess baseline conditions, and benchmark results against other utilities' experiences. These sources included the California Energy Commission's Database of Energy Efficiency Resources (DEER), ENERGY STAR®, the Energy Information Administration (EIA), and various utilities' annual and evaluation reports on energy efficiency and demand-response programs.

Energy Efficiency

The methodology used for estimating the technical and achievable technical energy efficiency potential draws upon standard industry practices, and proves consistent with the Council's assessments of conservation potentials for the Sixth Northwest Regional Power Plan (Sixth Plan). The general approach, shown in Figure 5 on the next page, illustrates how baseline and efficiency data have been combined to develop estimates of potential for use in PSE's IRP process.

The study considers three types of potential—naturally occurring, technical, and achievable technical.

Naturally occurring conservation refers to reductions in energy use that occur due to normal market forces, such as technological change, energy prices, market transformation efforts, and improved energy codes and standards. This analysis accounted for naturally occurring conservation in three ways:

- First, the assessment accounted for gradual efficiency increases due to the retirement of older equipment in existing buildings and the subsequent replacement with units that meet minimum standards at that time. For some end uses, the technical potential associated with certain

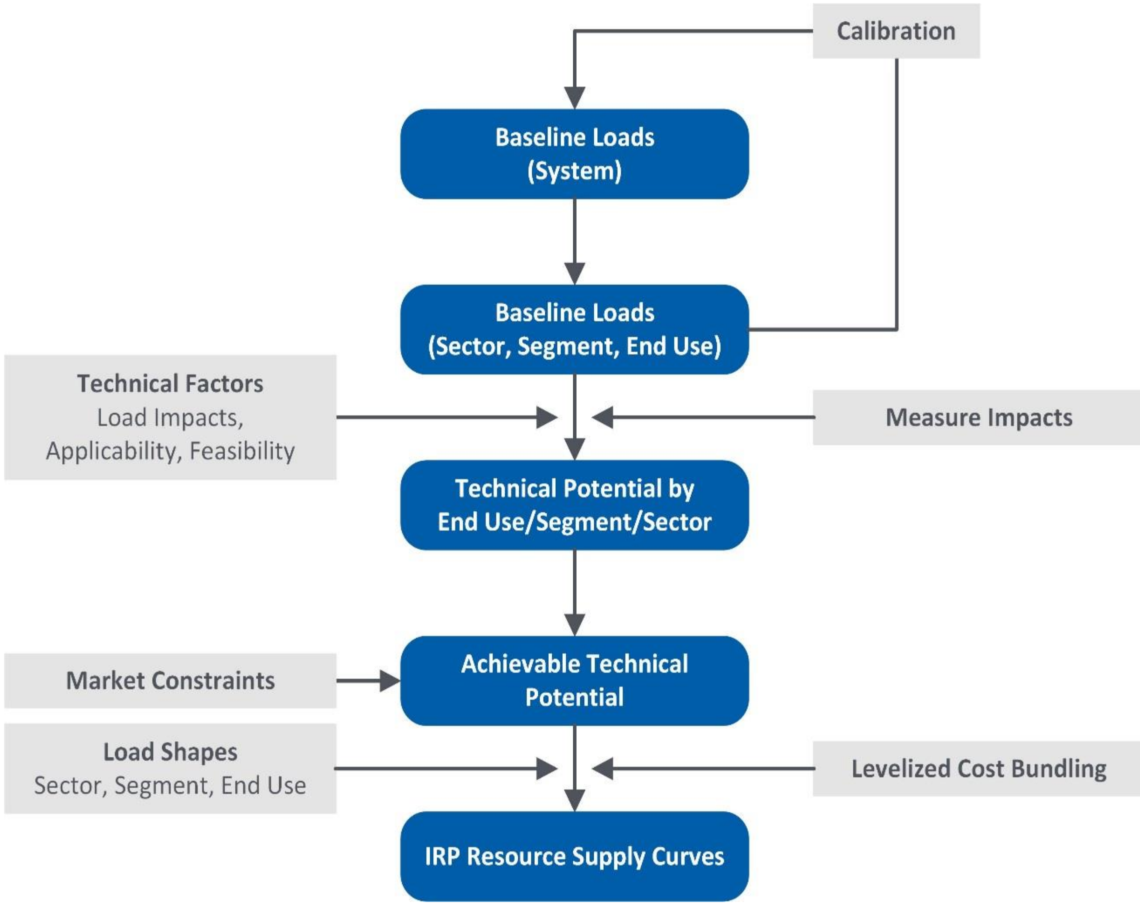
7 The first two studies are not publicly available. Northwest Energy Efficiency Alliance. *2007 Commercial Building Stock Assessment (CBSA).* Available online: http://neea.org/resource-center/regional-data-resources/commercial-building-stock-assessment.

8 Regional Technical Forum. "Simplified Energy Enthalpy Model." Available online at: http://www.nwcouncil.org/energy/rtf/measures/support/SEEM/Default.asp.

energy-efficient measures assumed a natural adoption rate. For example, savings associated with ENERGY STAR appliances accounted for current trends in customer adoption.

- Second, energy consumption characteristics of new construction reflected current state-specific building codes.

Figure 5. General Methodology for Assessment of Energy-Efficiency Potentials



- Third, the assessment accounted for improvements to equipment efficiency standards that are pending and will take effect during the planning horizon. The assessment did not, however, forecast changes to standards that have not passed; rather, it treated these at a "frozen" efficiency level.
- These impacts resulted in a change in baseline sales, from which the technical and achievable technical potential could be estimated.

Technical potential includes all technically feasible energy-efficient measures, regardless of costs or market barriers. Technical potential divides into two classes—discretionary (retrofit) and lost-opportunity (new construction and replacement of equipment on burnout).

This study's technical potential estimations for energy efficiency resources drew upon best-practice research methods and standard analytic techniques in the utility industry. Such techniques remained consistent with conceptual approaches and methodologies used by other planning entities, such as those of the Council in developing regional energy efficiency potential, and remained consistent with methods used in PSE's 2009, 2011, and 2013 assessments.

Achievable technical potential represents the portion of technical potential that might reasonably be achievable in the course of the 20-year planning period, given the possibility that market barriers could impede customer adoption. At this point, it does not consider cost-effectiveness, because identified levels of achievable technical potential principally serve as planning guidelines and information for the IRP process.

Developing sound utility IRPs requires knowledge of alternative resource options and reliable information on the long-run resource potential of achievable technologies. Demand-side management (DSM) resource potential studies principally seek to develop reasonably reliable estimates of the magnitude, costs, and timing of resources likely available over the planning horizon's course; they do not, however, provide guidance as to *how* or by *what means* identified resources might be acquired. For example, identified potential for electrical equipment or building shell measures might be attained through utility incentives, legislative action instituting more stringent efficiency codes and standards, or other means.

The resources considered for this study include energy efficiency measures that fall outside of PSE's traditional programs but that are currently or may be considered market transformation initiatives by NEEA. Televisions and heat pump dryers are examples of measures that are included in this study and that NEEA has pursued or is considering pursuing via market transformation.

Overview to Estimating Energy Efficiency Potential

Estimating energy efficiency potential draws on a sequential analysis of various energy-efficient measures in terms of technical feasibility (technical potential) and expected market acceptance, considering normal barriers possibly impeding measure implementation (achievable technical potential). The assessment followed three primary steps:

- ***Baseline forecasting.*** Determining 20-year future energy consumption by state, sector, market segment, and end use. The study calibrated the base year, 2015, to PSE's sector load forecasts. As described above, the baseline forecasts shown in this report include the Cadmus team's estimated impacts of naturally occurring potential.[9]

[9] The Cadmus team's baseline forecast accounted for codes and standards not embedded in PSE's load forecast. Due to these adjustments, 2035 baseline sales presented in this report may not match PSE's official load forecast.

- ***Estimation of alternative forecasts of technical potential.*** Estimating technical potential, based on alternative forecasts, which reflect technical impacts of specific energy-efficient measures.
- ***Estimation of achievable technical potential.*** Achievable technical potential calculated by applying ramp rates and an achievability percentage to the technical potential, as this section later describes in detail.

This approach offered two advantages:

- First, savings estimates would be driven by a baseline calibrated to PSE's base year (2015) sales. Although subsequent baseline years may differ from PSE's load forecast, comparisons to PSE's sales forecast helped control for possible errors. Other approaches may simply generate the total potential by summing estimated impacts of individual measures, which can result in total savings estimates representing unrealistically high or low baseline sales percentages.
- Second, the approach maintained consistency among all assumptions underlying the baseline and alternative (technical and achievable technical) forecasts. The alternative forecasts changed relevant inputs at the end-use level to reflect impacts of energy-efficient measures. Because estimated savings represented the difference between the baseline and alternative forecasts, they could be directly attributed to specific changes made to analysis inputs.

Developing Baseline Forecasts

As shown, the first step entails creating a baseline (no-DSR) forecast. In the residential and commercial sectors, the analysis relies on a bottom-up forecasting approach, beginning with annual consumption estimates by segment, end use, and equipment efficiency level. Average base-year use per customer can then be calculated from saturations of equipment, fuel, and efficient equipment. Comparisons to PSE's historical use per customer validates these estimates, and a forecast of future energy sales can then be created based on expected new construction and equipment turnover rates.

In the industrial sector, as standard practice, PSE's industrial forecast has been disaggregated to end uses, based on data available from the EIA'S Manufacturing Energy Consumption Survey.[10]

To bundle potential by cost, Cadmus collected data on measure costs, savings, and market size at the most granular level possible. Within each fuel and sector, the study distinguished between customer segments or facility types and their respective applicable end uses. We then conducted the analyses for these customer segments:

- 6 residential segments (existing and new construction for single-family, multifamily, and manufactured homes)
- 22 commercial segments (11 building types within the existing and new construction vintages)

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[10] Energy Information Administration (EIA). "Manufacturing Energy Consumption Survey (MECS)." Available online: http://www.eia.gov/consumption/manufacturing/index.cfm

- 17 industrial segments (17 facility types, treated only as an existing construction vintage)

Estimating Technical Potential

An important aspect of technical potential is that it assumes installation of the highest-efficiency equipment, wherever possible. For example, this study examines solar water heaters, heat pump water heaters, and efficient storage water heaters in residential applications with technical potential, assuming that, as equipment fails or new homes are built, customers will install solar water heaters wherever technically feasible regardless of cost. Where applicable, heat pump water heaters are assumed to be installed in homes ineligible for solar water heaters. Efficient storage water heaters are assumed to be installed in home ineligible for neither solar water heaters nor heat pump water heaters. The study treats competing non-equipment measures in the same way, assuming installation of the highest-saving measures, where technically feasible.

In estimating technical potential, one cannot merely sum up savings from individual measure installations, as significant interactive effects can result from installation of complementary measures. For example, upgrading a heat pump in a home where insulation measures have already been installed can produce fewer savings than in an uninsulated home.

Analysis of technical potential accounts for two types of interactions:

- ***Interactions between equipment and non-equipment measures.*** As equipment burns out, technical potential assumes it will be replaced with higher-efficiency equipment, reducing average consumption across all customers. Reduced consumption causes non-equipment measures to save less than they would have had equipment remained at a constant average efficiency. Similarly, savings realized by replacing equipment decrease upon installation of non-equipment measures.
- ***Interactions between non-equipment measures.*** Two non-equipment measures applying to the same end use may not affect each other's savings. For example, installing a low-flow showerhead does not affect savings realized from installing a faucet aerator. Insulating hot water pipes, however, would cause water heaters to operate more efficiently, thus reducing savings from either measure. This assessment accounts for this interaction by "stacking" interactive measures—iteratively reducing baseline consumption as measures are installed, thus lowering savings from subsequent measures.

Although, theoretically all retrofit opportunities in existing construction (often called "discretionary" resources) could be acquired in the study's first year, this would skew the potential for equipment measures and provide an inaccurate picture of measure-level potential.

Therefore, the study assumes realizations for these opportunities in equal annual amounts, over the 20-year planning horizon. By applying this assumption, natural equipment turnover rates, and other adjustments (described above), the study estimates annual incremental and cumulative potential by state, sector, segment, construction vintage, end use, and measure.

To estimate technical potential, Cadmus developed a comprehensive list of measures for all sectors, segments, and end uses. For the residential and commercial sectors, the study began by reviewing a broad range of energy-efficient measures. These measures were then screened to include only measures fitting these criteria:

- Commonly available
- Based on a well-understood technology
- Applicable to PSE's buildings and end uses

Industrial sector measures drew upon the Council's Sixth Plan and other general process improvement categories.[11]

As shown in Table 10, the study encompasses 350 unique electric energy-efficient measures and 153 unique gas energy-efficient measures. When expanded across segments, end uses, and construction vintages, this results in over 7,500 measures. (Appendix B.2 provides a comprehensive list of measures included in the analysis, with inputs and outputs provided in Appendix B.3.)

Table 10. Energy-Efficient Measure Counts by Fuel

Sector	Electric Measure Counts	Gas Measure Counts
Residential	145 unique 1142 permutations across segments	82 unique 581 permutations across segments
Commercial	159 unique 3288 permutations across segments	63 unique 1432 permutations across segments
Industrial	46 unique 979 permutations across segments	8 unique 125 permutations across segments

For every measure permutation contained in the study, the following key inputs, varying by segment and end use, were compiled:

- ***Measure savings.*** Energy savings associated with a measure as a percentage of the total end-use consumption. Sources include engineering calculations, energy simulation modeling, the RTF, the Council's Sixth Plan, and secondary sources such as ENERGY STAR and DEER.
- ***Measure costs.*** Per-unit cost (full or incremental, depending on the application) associated with measure installations. Sources include the Council's Sixth Plan, the RTF, DEER, RS Means, and merchant websites.
- ***Measure life.*** The measure's expected useful life (EUL). Sources include the Council's Sixth Plan, the RTF, DEER, and DSM program evaluations.

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[11] Industrial improvements derive from a variety of practices and specific measures, defined in the U.S. Department of Energy's Industrial Assessment Centers Database. Available online: http://www.iac.rutgers.edu/database/.

- ***Measure applicability.*** A general term encompassing a number of factors, such as the technical feasibility of installation, the measure's current saturation, measure interactions, competition, and projected market share. Where possible, applicability factors draw upon PSE survey data and account for PSE's energy efficiency program accomplishments.

The study created an alternate sales forecast, incorporating the effects of all technically feasible measures—the difference between this forecast and the baseline forecast represents the technical potential. This method allowed for long-term estimates of technical potential by measure, while accounting for changes in baseline conditions inherent in the baseline forecast.

The energy efficiency measures included in the study may not have a direct one-for-one correlation to the measures offered by PSE's programs and, for some measures, the per-unit savings for program measures may differ from the per-unit values assumed in the CPA. The primary reason for this discrepancy is that program measures depend on the delivery mechanism employed whereas the CPA remains agnostic to choices regarding the method of delivery. The best example of this type of discrepancy is for residential lighting measures. PSE's programs may have multiple savings values for the same LED or CFL depending upon whether the utility's customer acquires the bulb via retail or through direct install. Often times, the retail measure will include a "storage rate" or other adjustment factors that de-rate the per-unit savings values that would ultimately accrue to the program. Since the intent of the CPA is to estimate the remaining technical potential—and not to estimate the remaining program potential—it makes sense to ignore this adjustment.

Incorporation of Upcoming Codes and Standards

Electric

Although Cadmus' analysis does not attempt to predict how energy codes and standards may change, it captures information about enacted legislation, even if the legislation does not take effect for several years. The most notable, recent efficiency regulation has been the 2007 EISA, which set new standards for general service lighting, motors, and other end-use equipment. Capturing the effects of this legislation proved especially important, as residential lighting has played a large role in PSE's energy efficiency programs over the past several years.

EISA requires general service lighting to become roughly 30% more efficient than current incandescent technology, with standards phased in by wattage from 2012 to 2014. In addition to the 2012 phase-in, EISA contains a backstop provision that requires still higher-efficacy technologies, beginning in 2020.

Although the residential lighting backstop provision have the largest effect on potential, this study explicitly accounts for several other codes and standards. For the residential sector, these include dryer, freezer, heat pumps, and water heating standards. For the commercial sector, these include metal halide lamp fixtures, small electric motors, screw base incandescent bulbs, and water heating standards.

Table 11 provides a comprehensive list of standards enacted or pending starting in 2014 that Cadmus considered in this study. Standards prior to 2014 have been accounted for, such as commercial linear fluorescents, commercial electric motors, and residential ranges and ovens. It is worth noting that this study assumed the commercial linear fluorescent baseline is T-8 fixtures. Through discussions with PSE program staff, the future planning impact savings assume the baseline is T-8 with zero percent saturation of the T-12 fixtures.

Table 11. Enacted or Pending Standards Accounted For – Electric End Uses

Equipment Type	Existing (Baseline) Standard	New Standard	Sectors Impacted	Study Effective Year
Appliances				
Clothes washer	Federal standard 2007	Federal standard 2015	Residential	2016*
Clothes washer	Federal standard 2007	Federal standard 2018	Residential	2018
Dishwasher (residential style)	Federal standard 2010	Federal standard 2013	Commercial/Residential	2014*
Dryer	Federal standard 2011	Federal standard 2015	Residential	2015
Freezer (residential style)	Federal standard 2001	Federal standard 2014	Commercial/Residential	2015*
Refrigerator (residential style)	Federal standard 2001	Federal standard 2014	Commercial/Residential	2015*
Cooking				
Microwave	Existing conditions (no federal standard)	Federal Standard 2016	Residential	2016
HVAC				
Heat pump (air source)	Federal standard 2006	Federal standard 2015	Residential	2017**
Room air conditioners	Federal standard 2000	Federal standard 2014	Residential	2015*
Lighting				
Lighting general service lamp (EISA)	Existing conditions (no federal standard prior to EISA 2007)	Federal standard 2014 (phased in over three years)	Commercial/Residential	2014
Lighting general service lamp (EISA backstop provision)	Existing conditions (no federal standard prior to EISA 2007)	Federal standard 2020	Commercial/Residential	2020
Metal halide lamp fixtures	Federal standard 2009	Federal standard 2017	Commercial	2018*
Motors				
Small electric motors	Federal standard 1987	Federal standard 2015	Commercial	2016*
Water Heaters				

Equipment Type	Existing (Baseline) Standard	New Standard	Sectors Impacted	Study Effective Year
Water heater > 55 gallons	Federal standard 2004	Federal standard 2015	Commercial/Residential	2016*
Water heater ≤ 55 gallons	Federal standard 2004	Federal standard 2015	Commercial/Residential	2016*

*To estimate the potential, Cadmus assumed standards taking effect mid-year will begin on January 1 of the following year.
**Due to the uncertainty created by the litigation, DOE will not enforce this standard until July 1, 2016.

To ensure an accurate assessment of remaining potential, Cadmus created a new forecast, netting out the effect of future standards (shown in Figure 6 and Figure 7). This forecast drew upon a strict interpretation of the legislation, assuming that affected end uses would be replaced with technologies meeting minimum federal standards.

Figure 6. Residential Forecasts Before and After Adjusting for Standards

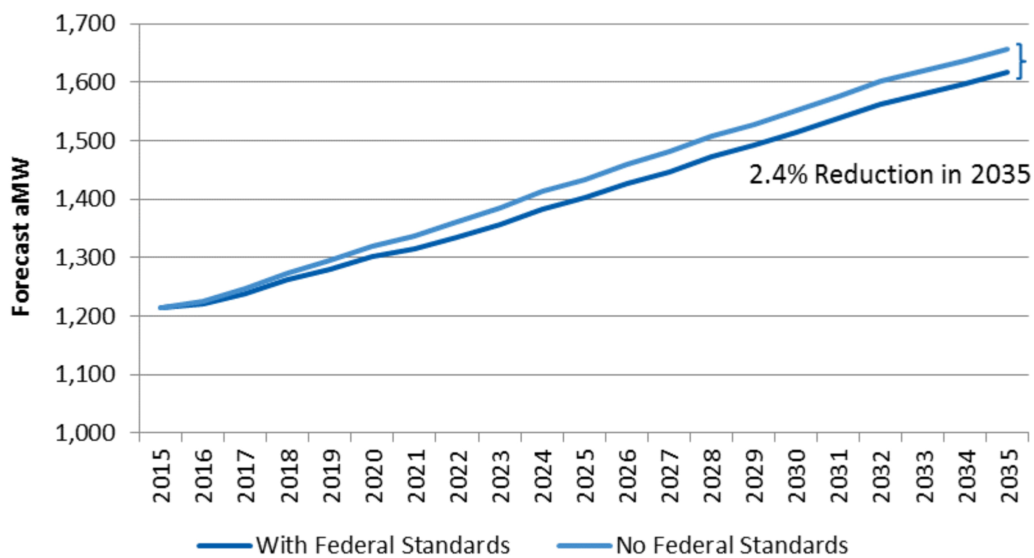
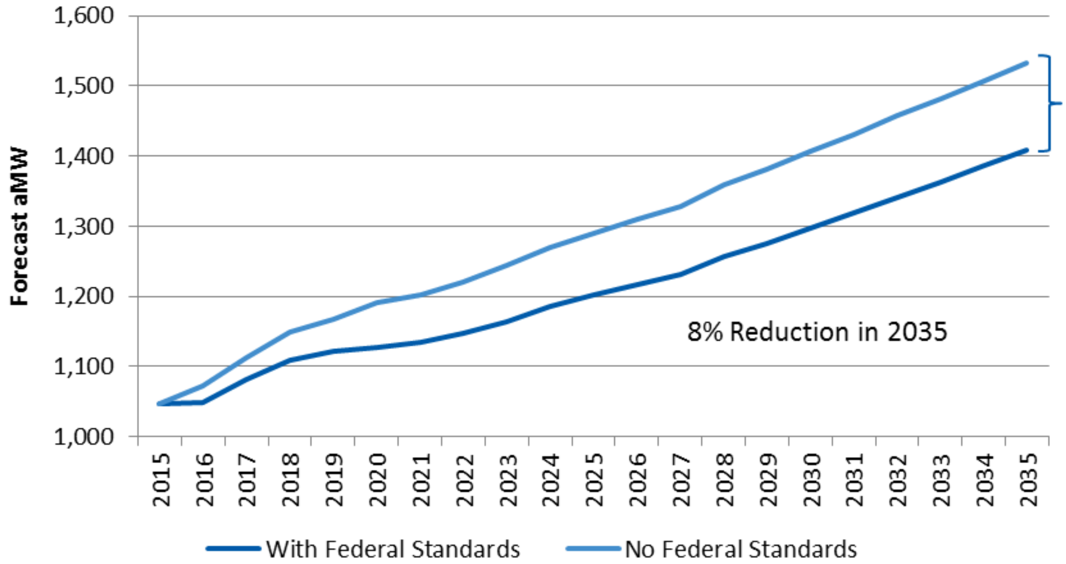


Figure 7. Commercial Forecasts Before and After Adjusting for Standards



After accounting for enacted and pending federal standards, the residential base case forecast fell by 2.4% in 2035, whereas the commercial base case forecast fell by 8%. Lighting standards primarily drove this lower consumption. The preceding figures indicate a drop in 2020 consumption due to the pending EISA backstop provision, which requires standard screw base bulbs to have a minimum efficacy of 45 lumens per watt.

Figure 8 and Figure 9 break out the impacts of federal standards on forecasted sales in each year of the study, by end use, for the residential and commercial sectors.

Figure 8. Impacts of Standards by End Use—Residential Sector

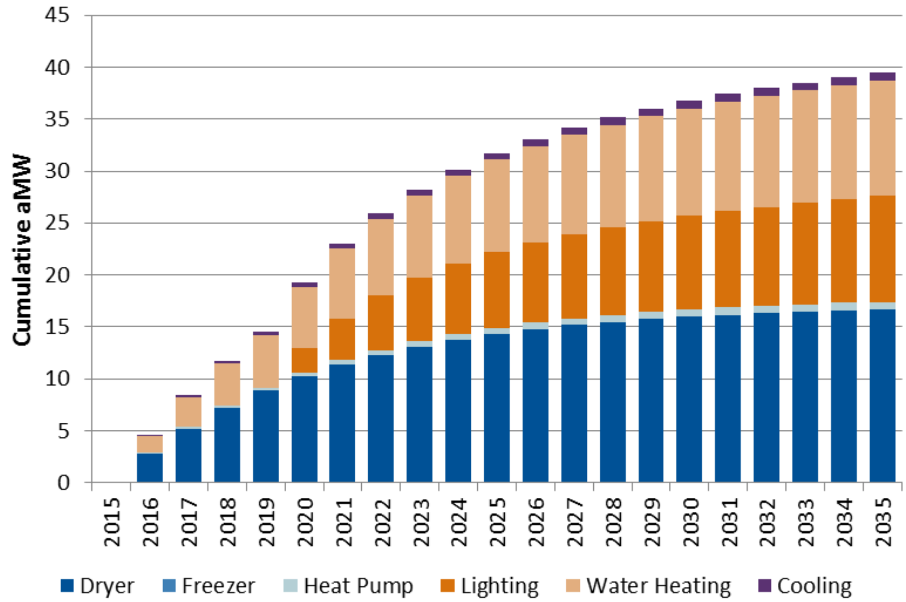
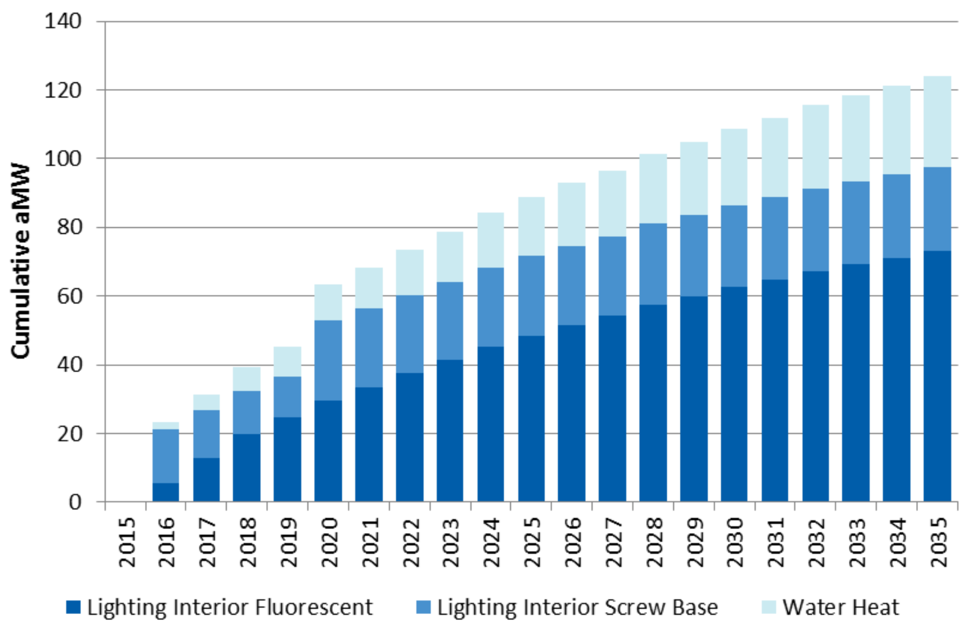


Figure 9. Impacts of Standards by End Use—Commercial Sector



Gas

Cadmus also captured the impact of DOE rulings on minimum efficiencies for water heaters and dryers. Overall, gas standards have a small impact on consumption. Standards reduce 2035 residential consumption by 20 million therms (2.3%) in the residential sector and 9 million therms (2.0%) in the commercial sector. If savings from the impact of standards were included in technical potential, they would account for 8% of residential savings and 4% of commercial savings in 2035.

Table 12 shows the enacted or pending standards for gas end uses. Previous standards prior to 2014 have been accounted for such boilers, furnaces, and residential ranges and ovens commercial electric motors, and residential ranges and ovens. It is worth noting that the new furnace legislation requiring 90% AFUE has been halted and the effective date is to be determined. The likely effective date is to be 2021 at the soonest. Therefore, the existing standard has been assumed for this study.

Table 12. Enacted or Pending Standards Accounted For – Gas End Uses

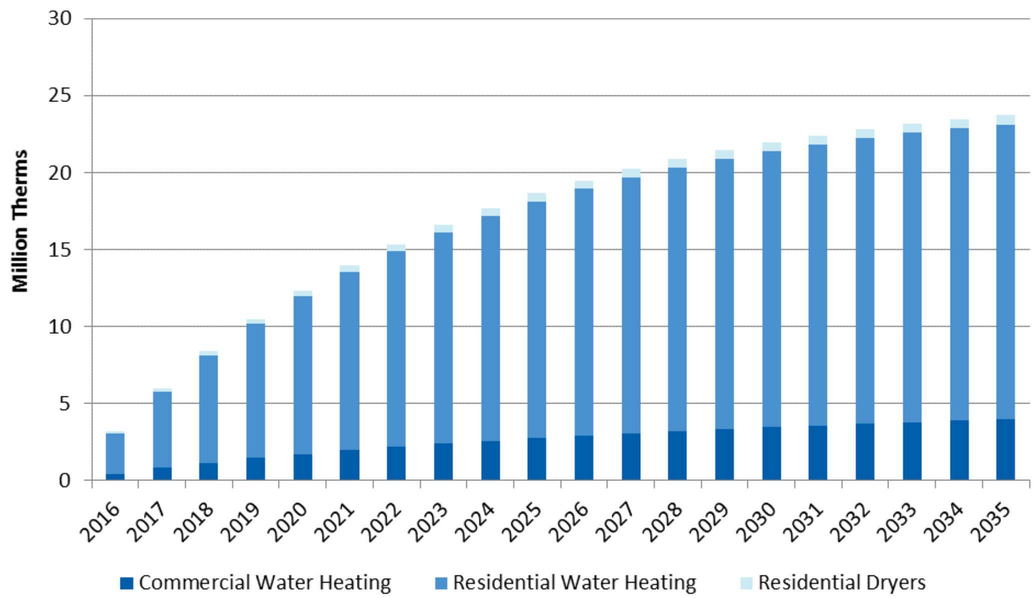
Equipment Type	Baseline	Standard	Sector	Study Year Effective
Water Heat				
Water Heater > 55 gallons	Federal standard 2004	Federal standard 2015	Commercial/Residential	2016*
Water Heater ≤ 55 gallons	Federal standard 2004	Federal standard 2015	Commercial/Residential	2016*
Appliances				
Dryer	Federal Standard 2011	Federal Standard 2015	Residential	2015

*To estimate the potential, Cadmus assumed standards taking effect mid-year will begin on January 1 of the following year.

Figure 10 shows the impacts of federal gas equipment standards. By 2035, 97% of savings due to the standards comes from water heating (and 3% comes from dryers).

Similar to electric, Cadmus created a gas standards bundle for inclusion in PSE's 2015 IRP. This bundle is treated as a zero-cost "must take" bundle. Including this bundle reduced technical potential compared to the 2013 IRP; savings that were previously captured by measures in the 2013 IRP are captured by standards in the 2015 IRP.

Figure 10. Impacts of Federal Gas Equipment Standards



Naturally Occurring Conservation

Cadmus' baseline forecast is inclusive of naturally occurring conservation, which refers to reductions in energy use that occur due to normal market forces, such as technological change, energy prices, market transformation efforts, and improved energy codes and standards. These impacts resulted in a change in baseline sales from which the technical and achievable technical potential were then estimated.

This analysis accounted for naturally occurring conservation in four ways:

- The potential associated with certain energy-efficient measures assumes a natural adoption rate and is net of current saturation. For example, the total potential savings associated with ENERGY STAR appliances accounts for current trends in customer adoption. As such, the total technical potential from ENERGY STAR appliances is reduced from the 2013 IRP and these savings are reflected in the baseline energy forecast.
- The assessment has accounted for gradual increases in efficiency due to retirement of older equipment in existing buildings, followed by replacement with units meeting or exceeding minimum standards at the time of replacement.
- The assessment has accounted for pending improvements to equipment efficiency standards that will take effect during the planning horizon, as discussed above. The assessment does not, however, forecast changes to standards that have not yet been passed.
- New construction consumption characteristics reflect the Washington State Energy Code (WSEC) that went into effect in 2011. All energy-efficient measures in this study meet or exceed WSEC and, where applicable, energy savings are calculated using a WSEC baseline. For example, current building code requires R-49 ceiling insulation, so energy savings for all ceiling insulation measures are calculated with R-49 as a baseline. Consequently, this study does not attribute

savings to ceiling insulation levels below R-49 in new construction. It should be noted that building codes have the smallest impact of the four classes of naturally occurring conservation given that they apply only to new construction.

Achievable Technical Potential

Achievable technical potential can be defined as the portion of technical potential expected to be reasonably achievable over the course of a planning horizon. This estimate accounts for likely acquisition rates and market barriers to customer adoption, but it does not address cost-effectiveness or acquisition mechanisms (e.g., utility programs, codes and standards, market transformation). Thus, the savings a utility can expect to acquire cost-effectively may be substantially lower than the achievable technical potential estimate.

This study, consistent with the Council's Sixth Plan, assumes an 85% achievability factor for electric energy efficiency. For lost opportunity measures, this number (applied directly to the total technical potential for discretionary measures) ramps in at a rate determined by the technology and its useful life. Given this ramp-up, less than 85% of the lost opportunity potential will be acquired over the planning horizon, consistent with the Council's methodology.[12]

Due to higher upfront equipment costs for gas resources, Cadmus assumes 75% of the technical potential can be achieved over the planning horizon.

As previously discussed, lost opportunity measures experience inherent technical ramping, which are based on new construction and equipment turnover rates. In contrast, discretionary opportunities can be acquired at any point.

This study assumes all achievable electric and gas discretionary measures can be acquired within 10 years. (PSE considered this 10-year accelerated ramp-in for discretionary measures as a reasonable representation of the overall energy savings acquisition rate for resource planning analyses. Actual market ramp rates will vary for specific measures.)

Fuel Conversion

In the study's context, fuel conversion refers to electric savings opportunities involving substitution of natural gas for electricity through replacements of space heating systems, water heating equipment, and appliances. The study considers fuel conversion for existing single-family homes, existing and new multifamily buildings, and existing and new commercial facilities—the segments considered most likely and able to convert.

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[12] This remains consistent with the Council's assumption that 65% of lost opportunity resources can be acquired, as discussed in its report, *A Retrospective Look at the Northwest Power and Conservation Council's Conservation Planning Assumptions.* April 2007. Available online: http://www.nwcouncil.org/library/2007/2007-13.htm.

Cadmus' analysis extends the energy efficiency analysis described above, identifying applicable equipment and customers based on these criteria:

- Customers must be within PSE's combined service territory (i.e., areas where PSE provides both electricity and natural gas).
- Customers must be existing gas customers or on a gas main.
- For existing construction, customers must have a ducted system for space heating conversion.
- New natural gas equipment must meet energy efficiency program criteria (e.g., 95% AFUE furnace, ENERGY STAR water heater).

Once eligible populations for each equipment type could be identified, we compiled measure costs and savings, consistent with the energy efficiency analysis. We accounted for additional upfront costs required due to natural gas conversion (e.g., line extensions, piping). We treated the cost of natural gas consumed over the life of a measure, based on forecasted avoided costs, as an O&M cost and included it in the calculation of the cost of conserved electricity.

As with energy efficiency, the technical potential assumes all eligible pieces of equipment can be converted to natural gas. Achievability draws upon results from PSE's 2008 fuel conversion survey, which asked customers about the likelihood they would participate at various incentive levels. Using results of this survey, this analysis assumes that 63% of technical potential can be achieved; this is the value associated with self-reported customer participation, if PSE covered the entire incremental cost of conversion. Available potential is assumed to be acquired in equal amounts annually over the 20-year planning horizon.

Demand Response

Demand response programmatic options seek to achieve the following:

- Help reduce peak demand during system emergencies or periods of extreme market prices
- Promote improved system reliability

Benefits from demand response resources accrue by providing incentives for customers to curtail loads during utility-specified events (e.g., direct load control [DLC]), or by offering pricing structures to induce participants to shift load away from peak periods (e.g., critical peak pricing programs).

Cadmus' analysis focused on program options that include residential DLC for space heat, room heat, and nonresidential load curtailment. These strategies include price- and incentive-based options for all major customer segments and end uses within PSE's service territory, with the list informed by the 2013 IRP, PSE's demand response pilot program experience, and programs offered by other utilities.

General Approach

This study utilizes a hybrid, top-down, and bottom-up approach for estimating demand response potentials.

The approach began by using utility system loads, disaggregated into sector, segment, and applicable end uses. For each program, Cadmus first assessed potential impacts at the end-use level. End-use load impacts then could be aggregated to obtain estimates of technical potentials. This allowed market factors, such as likely program and event participation levels, to be applied to technical potentials to obtain estimates of market potentials. General analytic steps involved in estimating market potential (with the exception of the residential DLC programs) are:

1. Define customer sectors, market segments, and applicable end uses. In estimating the load basis, the study first defined customer sectors, customer segments, and applicable end uses, similar to those used in estimating energy efficiency potentials. System loads were disaggregated into three sectors—residential, commercial, and industrial. The study further broke each sector down by market segment (as shown in Table 13), and end use (such as cooking, cooling, heating, heat pumps, HVAC, lighting, plug load, refrigeration, space heat, and hot water heating).

Table 13. Customer Sectors and Segments

Residential	Commercial	Industrial
Single Family	Dry Goods Retail	Chemical Manufacturing
Multifamily	Grocery	Electronic Equipment Manufacturing
Manufacture Homes	Hospital	Fabricated Metal Products
	Hotel/Motel	Food Manufacturing
	Multifamily Common Area	Industrial Machinery
	Office	Miscellaneous Manufacturing
	Other	Nonmetallic Mineral Products
	Restaurant	Paper Manufacturing
	School	Petroleum Refining
	University	Plastics, Rubber Products
	Warehouse	Primary Metal Manufacturing
		Printing-related Support
		Streetlights
		Transportation Equipment Manufacturing
		Wastewater
		Water
		Wood Products Manufacturing

2. Compile utility-specific sector/end-use loads. Establishing reliable estimates of demand response potentials depended on correct characterizations of sector, segment, and end-use loads. The study developed load profiles for each end use and determined contributions to system peak of each end use, based on end-use load shapes.
3. Screen customer segments for eligibility. This step involved screening customer segments for applicability of specific program strategies. For example, only customers with maximum monthly

demand of at least 100 kW could be considered eligible for the nonresidential load curtailment program.

4. Estimate technical potential. Technical potential for each program was assumed to be a function of customer eligibility in each class, affected end uses in that class, and the expected strategy impact on targeted end uses. Analytically, technical potential (TP) for each demand-response program option (p) was calculated as the sum of impacts at the end-use level (e), generated in customer sector (s) by:

$$TP_p = \sum_{es} TP_{pes}$$

and

$$TP_{pes} = LE_{ps} \times LI_{pes}$$

where,

LE_{ps} (load eligibility) represented the portion of customer sector (s) loads (MW) applicable for program option (p), referenced as “Eligible Load” in the program assumptions.

LI_{pes} (load impact) was the percentage reduction in end-use load (e) for each sector (s) resulting from the program (p), referenced as “Technical Potential as % of Load Basis” in the program assumptions.

5. Estimate market potential. Market potential accounted for customers’ ability and willingness to participate in capacity-focused programs, subject to their unique business or household priorities, operating requirements, and economic (price) considerations. Market potential estimates derived from adjusting the technical potential by two factors—expected program participation rates (the percentage of customers likely to enroll in the program) and expected event participation rates (the percentage of customers that will participate in a demand response event—applicable to programs such as the residential DLC program). Market potential for the program option (MP_p) was calculated as the product of technical potential for the customer sector (s), program participation (sign-up) rates (PP_{ps}), and expected event participation (EP_{ps}) rates:

$$MP_p = TP_{ps} \times PP_{ps} \times EP_{ps}$$

6. Estimate costs and develop supply curves. The levelized cost ($/kW-year) of each program option was calculated using estimates of program development, technology, incentive, ongoing maintenance, administration, and communications costs.

Residential DLC

Residential DLC proves unique in that, unlike other demand response options, it affects specific end uses and equipment (e.g., room heaters and water heaters). Therefore, market potential may be quantified more directly as the product of four variables:

- The number of eligible customers
- Expected per unit (kW) impacts

- Equipment saturation rate
- Expected program participation

Derivation of Per-Unit Impacts

PSE implemented a DLC pilot program from October 2009 through September 2011. This pilot program targeted residential customers with electric space or room heat and/or electric water heat. DLC switches were installed on the customers' heating systems and/or water heaters so these end uses could be cycled on and off during peak events. Cadmus relied on the kW impact per switch, as reported in PSE's 2011 Evaluation, Measurement, and Verification (EM&V) Report,[13] to calculate the market potential for a full-scale program. As the EM&V report calculated impacts for morning, afternoon, and evening events, Cadmus weighted these results based on the composition of the top 20 system hours during which events would be called in a full-scale program. The general program assumptions in Chapter 4 provide per-switch impacts.

Equipment Saturation Rates

Equipment saturation represents the percentage of customers eligible for participating in the program (i.e., to participate in the DLC program, a customer must have an electric furnace or electric room heat). Equipment saturation levels for each residential customer segment were derived from PSE data and were consistent with saturations used to estimate energy-efficiency potential.

Expected Participation

Due to the rarity of electric heating DLC programs, and the minimal data existing on participation rates for such programs, Cadmus relied on the average participation rate for national DLC cooling programs and on PSE's experience.

Distributed Generation

With the exception of solar PV, this study did not re-estimate distributed generation potentials. However, Cadmus has updated the costs of the other distributed generation resources, with results presented in a summary table in the Distributed Generation section later in this report. For detailed information regarding distributed generation potentials, see Cadmus' 2008 report.[14]

Incorporation of Demand Side Resources into PSE's IRP

In addition to the energy efficiency, fuel conversion, and distributed generation resource bundles, PSE included three other resource bundles in its IRP:

- The expected effects of codes and standards (including EISA)
- Capacity-only impacts of demand response

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13 Evaluation, Measurement, and Verification (EM&V) Report.

14 http://www.pse.com/SiteCollectionDocuments/2009IRP/AppL1_IRP09.pdf.

- Savings associated with distribution of efficiency improvements (outside the scope of this study)

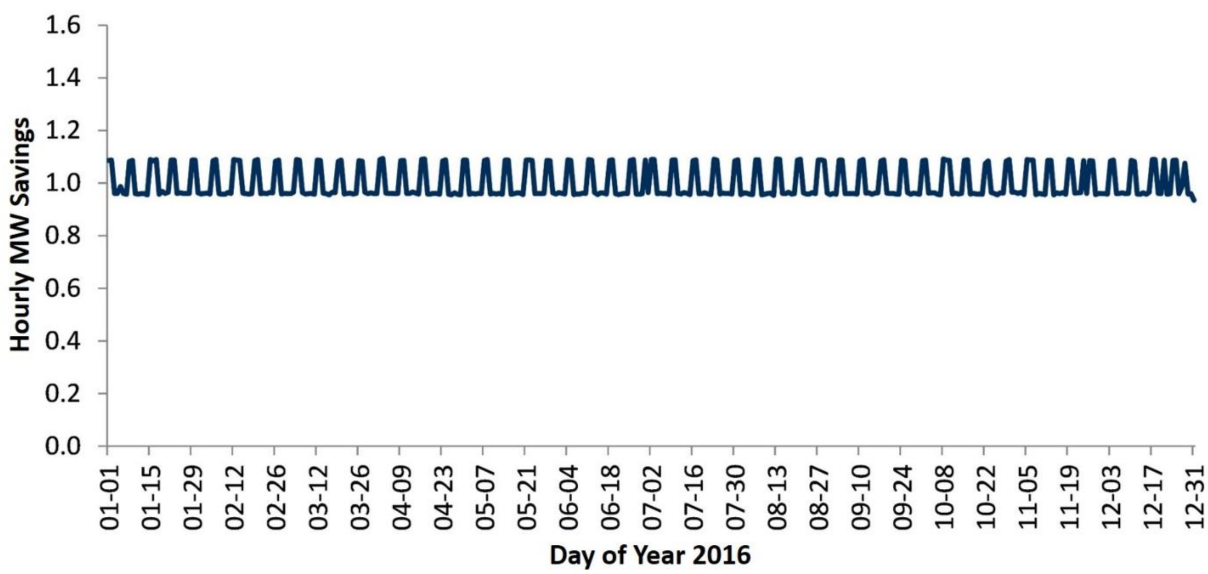
In this section, Cadmus presents how it derived hourly inputs for PSE's IRP model from the annual estimates developed for each of the energy efficiency, fuel conversion, and distributed generation resource bundles.

About Hourly DSR Estimates

Annual reporting of energy savings is appropriate from the perspective of energy efficiency programs and Washington Initiative 937 (I-937) compliance.[15] But from a resource planning perspective, the focus must shift to hourly energy savings. However, simply spreading the annual DSR over an hourly load shape is not sufficient. In this section, Cadmus discusses its methodology for allocating annual savings to an hourly level for the 2015 IRP.

Cadmus developed hourly DSR estimates for each resource bundle in two steps. First, we spread the annual achievable technical potential for each measure over an hourly load shape. As an example, Figure 11 shows hourly savings for a residential lighting measure with 1 aMW of achievable potential in the year 2016. This represents hourly savings from the perspective of the I-937 compliance.

Figure 11. Example - Compliance Perspective Year 2016 Hourly Savings Spread

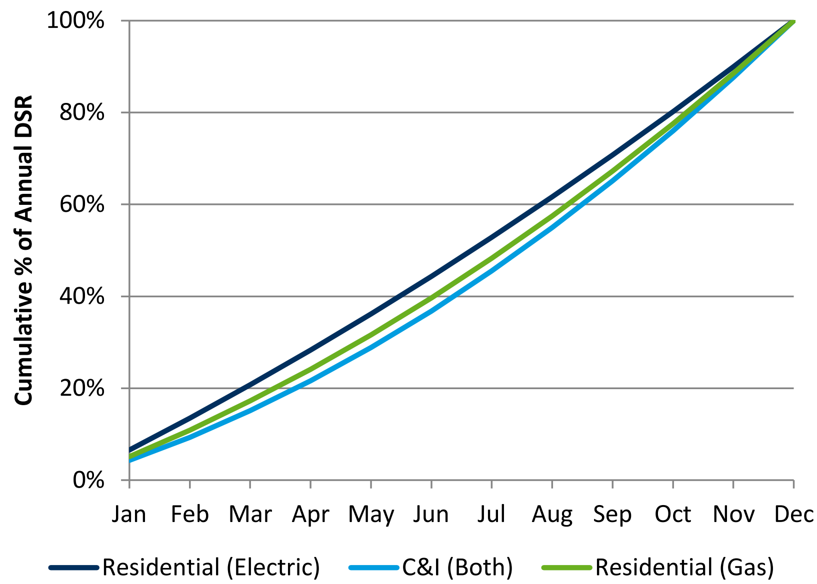


However, as this figure shows, this perspective implicitly assumes that all of the 1 aMW of annual savings are obtained in 2016 on the first hour of January 1, 2016. Realistically, this is not attainable and overstates the actual amount of DSR available in a given hour, especially early in the year.

15 Washington Initiative 937, a clean energy initiative passed in 2006. Available online: http://www.secstate.wa.gov/elections/initiatives/text/i937.pdf.

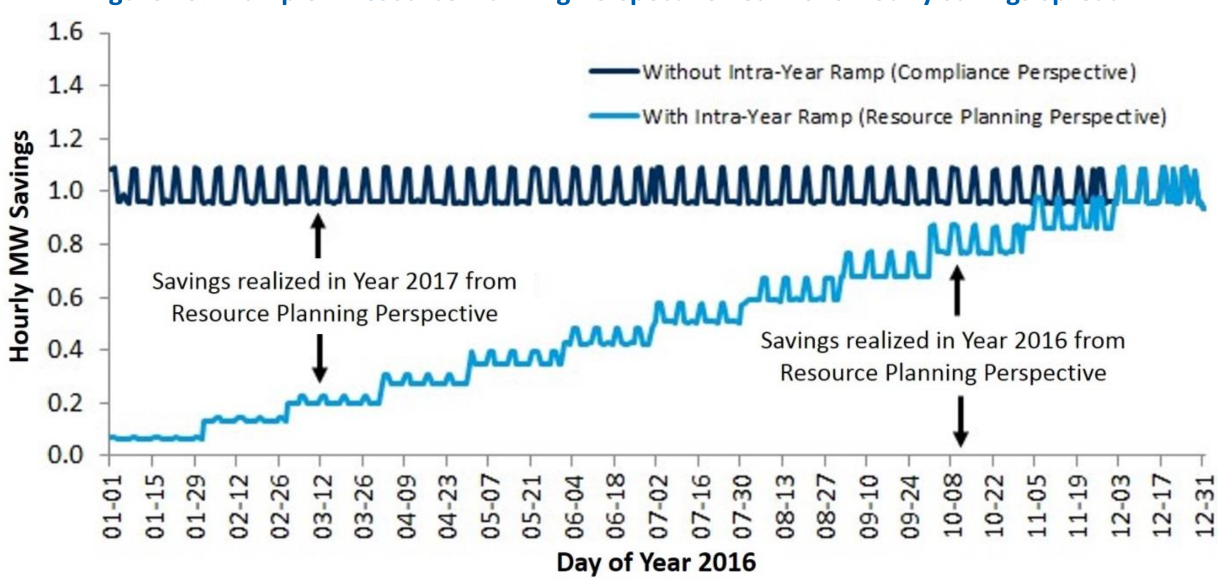
Consequently, PSE provided Cadmus an intra-year schedule based on historic trends in DSR acquisition that PSE used to ramp the achievable technical potential throughout the year. As shown in Figure 12, the fraction of annual DSR available in a given month grows throughout the year until it reaches 100% in December.

Figure 12. Intra-Year Ramping by Sector and Fuel



In the second step of the process, Cadmus laid the intra-year ramping over the hourly savings from the first step so the IRP model explicitly assumes that only a small fraction of the annual savings is available in the month of January. Using the same 1 aMW example, the result is shown in Figure 13.

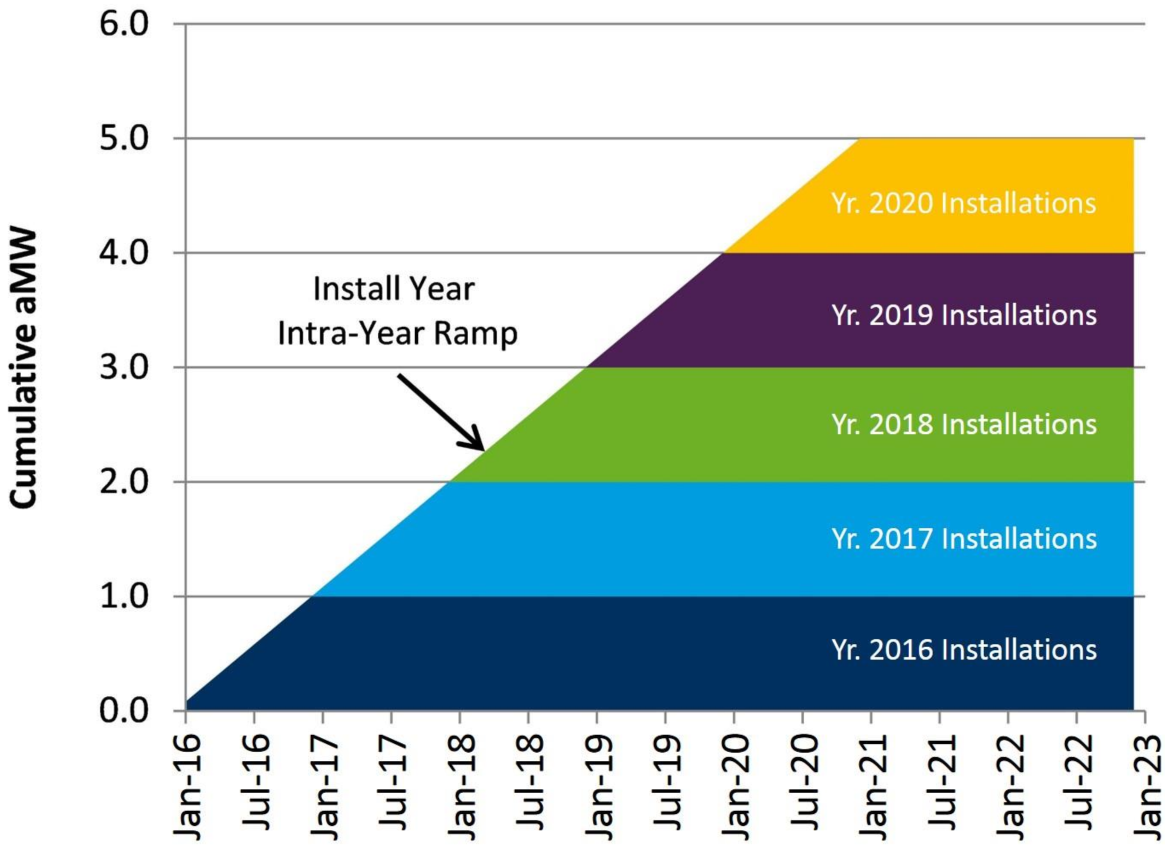
Figure 13. Example – Resource Planning Perspective Year 2016 Hourly Savings Spread



Cadmus notes that in this example the year 2016 energy savings, after applying intra-year ramping, is approximately one half of the savings without intra-year ramping because of the way in which those savings were acquired throughout the year. From a resource planning perspective, the "missing" half of the savings from measures installed in 2016 are realized in 2017. (Not shown in Figure 13 are the savings from measures installed during calendar year 2015 that are realized in 2016; those savings are reflected in the load forecast.) The ramped savings shape shown in Figure 13 is applicable only for the first year that a measure is installed. The IRP model assumes full savings beyond the first year of installation.

Figure 14 shows a stylized example of this concept, assuming that the same measure used in the examples above has 1 aMW of annual, incremental achievable technical potential in each of the years 2016 through 2020.

Figure 14. Example: Intra-Year Ramping Beyond Year of Installation



Energy Efficiency Potentials

Scope of Analysis

PSE seeks accurate estimates of available energy efficiency potential, essential for its IRP and program planning efforts. To support these efforts, Cadmus performed an in-depth assessment of technical potential and achievable technical potential for electric and natural gas resources in the residential, commercial, and industrial sectors. PSE could then bundle these potentials in terms of levelized costs of conserved energy so that the IRP model can determine the optimal amount of energy efficiency potential PSE should select.

The next section is in two parts—summaries of resource potentials by fuel and detailed results by fuel and sector.

Summary of Resource Potentials—Electric

Table 14 shows 2035 forecasted baseline electric sales and potential by sector.[16] Cadmus' analysis indicates that 781 aMW of technically feasible electric energy efficiency potential will be available by 2035, the end of the 20-year planning horizon. This translates to an achievable technical potential of 622 aMW. Should all of this potential prove cost-effective and realizable, it will result in a 20% reduction in 2035 forecasted retail sales.

Table 14. Electric Energy Efficiency Potential by Sector, Cumulative in 2035

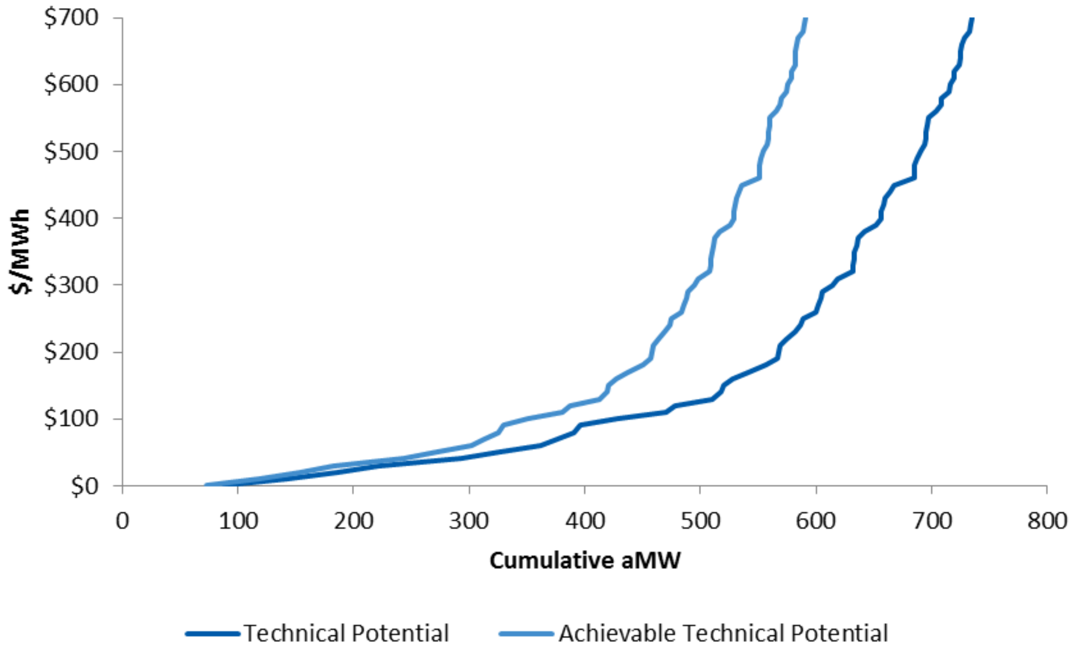
		Technical Potential		Achievable Potential	
Sector	2035 Baseline Sales (aMW)	Technical Potential (aMW)	Percentage of Baseline Sales	Achievable Technical Potential (aMW)	Percentage of Baseline Sales
Residential	1,616	390	24%	304	19%
Commercial	1,409	360	26%	293	21%
Industrial	129	30	23%	26	20%
Total	3,154	781	25%	622	20%

Figure 15 illustrates the relationship between identified technical potential and achievable technical potential and the corresponding cost of conserved electricity.[17] For example, approximately 413 aMW of achievable potential exists, at a cost of less than or equal to $130 per MWh.

16 These savings derive from forecasts of future consumption, absent any utility program activities. Although consumption forecasts account for the savings PSE has acquired in the past, the estimated potential is inclusive of—not in addition to—current or forecasted program savings.

17 In calculating levelized costs of conserved energy, non-energy benefits are treated as a negative cost. This leads to some measures having a negative cost of conserved energy, although incremental upfront costs would occur.

Figure 15. Electric DSR Supply Curves—Cumulative in 2035*[a]



*The maximum cumulative technical potential shown in this figure is less than technical potential reported in Table 14 because resources above $700/MWh are not shown.

Figure 16 shows the cumulative potential annually available in each sector. The study assumes all discretionary resources will be acquired on a 10-year schedule between 2016 and 2025. The 10-year acceleration of discretionary resources will lead to the change in slope after 2025, at which point lost opportunity resources offer the only remaining potential.

Figure 16. Electric Energy Efficiency Acquisition Schedule by Sector

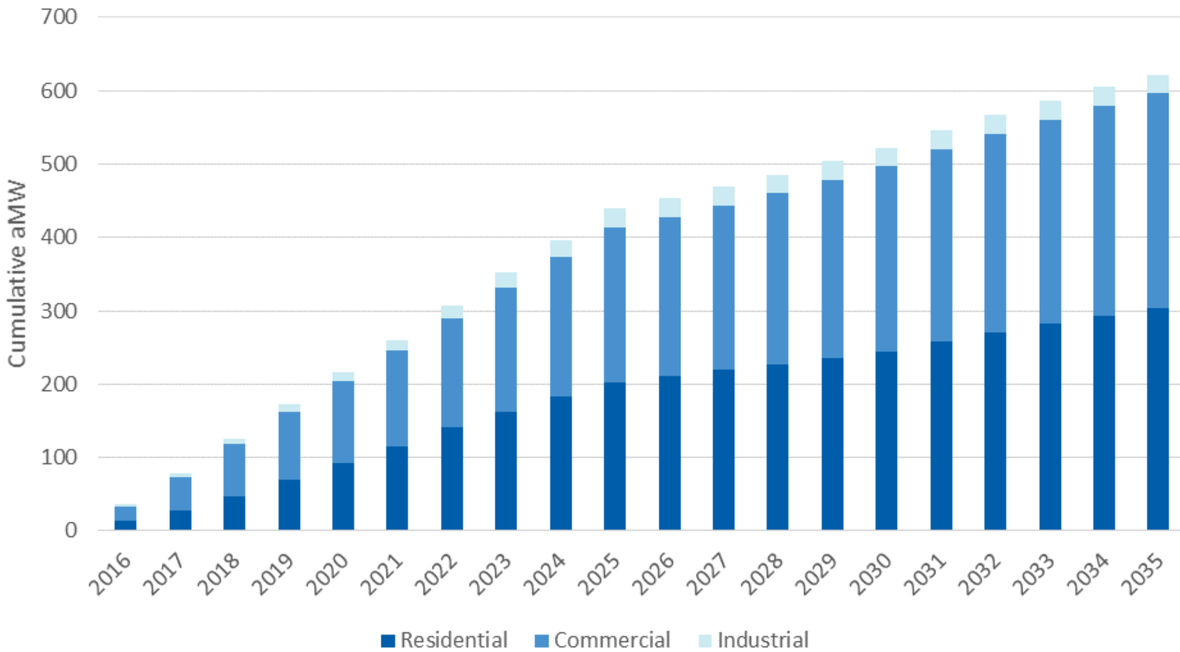
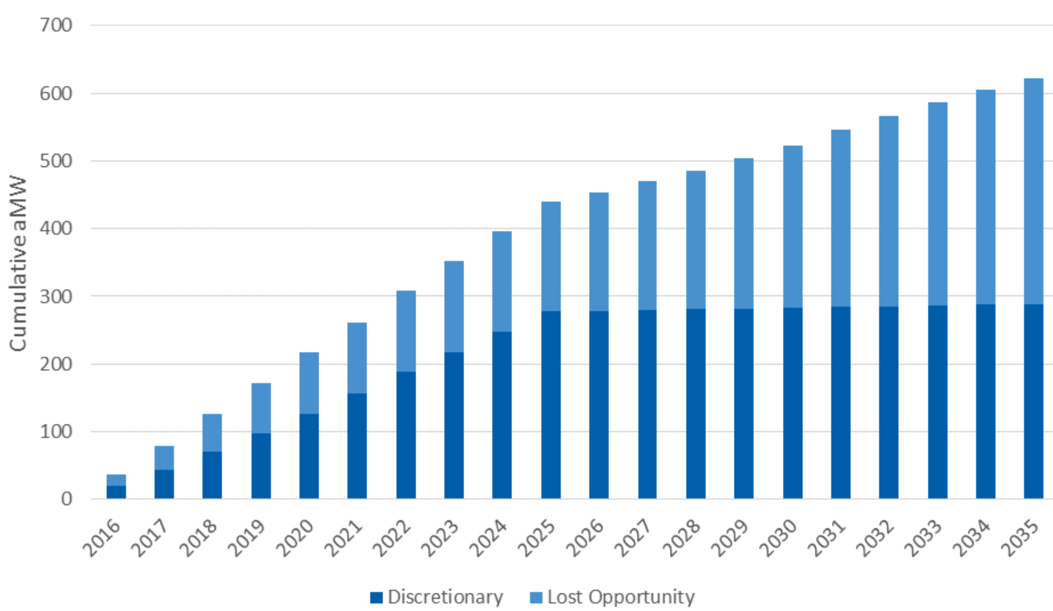


Figure 17 shows cumulative annual achievable electric savings by resource type (discretionary versus lost opportunity). Overall, discretionary measures account for 46% of cumulative savings in 2035, and lost opportunity measures account for the remaining 54%.

Figure 17. Electric Cumulative Annual Achievable Technical Potential by Resource Type



Summary of Resource Potentials—Natural Gas

Table 15 illustrates the 2035 forecasted baseline natural gas sales and potential by sector. As shown, study results indicate roughly 331 million therms of technically feasible energy efficiency potential by 2035, the end of the 20-year planning horizon. This translates to an achievable technical potential of 225 million therms. Should all of this potential prove cost-effective and realizable, it will amount to a 17% reduction in 2035 forecasted retail sales.

Table 15. Natural Gas Energy-Efficiency Potential by Sector, Cumulative in 2035

		Technical Potential		Achievable Technical Potential	
Sector	2035 Baseline Sales (Million Therms)	Million Therms	As Percentage of Baseline	Million Therms	As Percentage of Baseline
Residential	844	217	26%	140	17%
Commercial	440	108	25%	81	18%
Industrial	23	6	27%	5	20%
Total	1,307	331	25%	225	17%

Figure 18 illustrates the relationships between identified technical potential and achievable technical potential and the corresponding costs of conserved energy. For example, roughly 48 million therms of achievable potential will be available, at a cost of less than $1 per therm.

Figure 18. Natural Gas DSR Potential Supply Curves, Cumulative in 2035

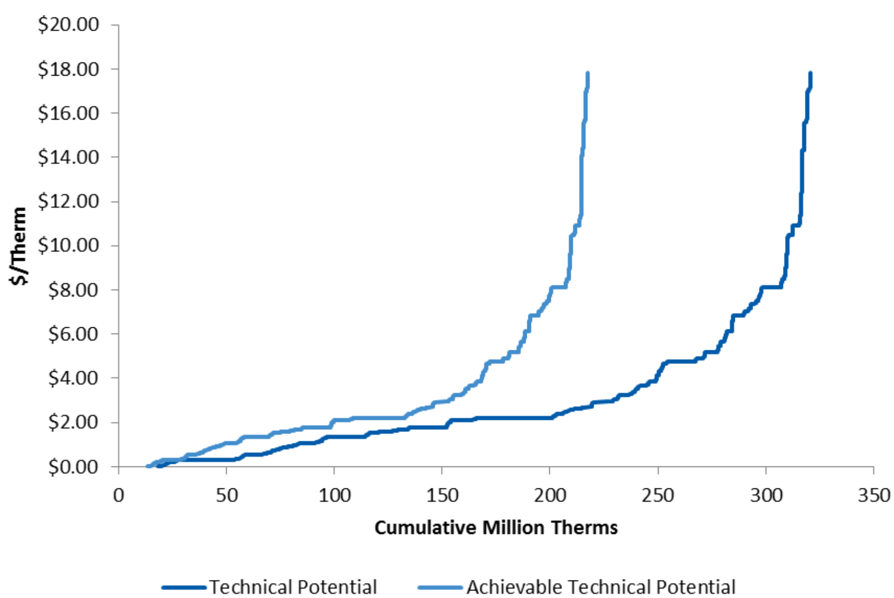


Figure 19 shows the cumulative potential annually available in each sector. As with electric potential, the study assumes all achievable discretionary opportunities will be acquired over 10 years.

Figure 19. Natural Gas Energy-Efficiency Acquisition Schedule by Sector

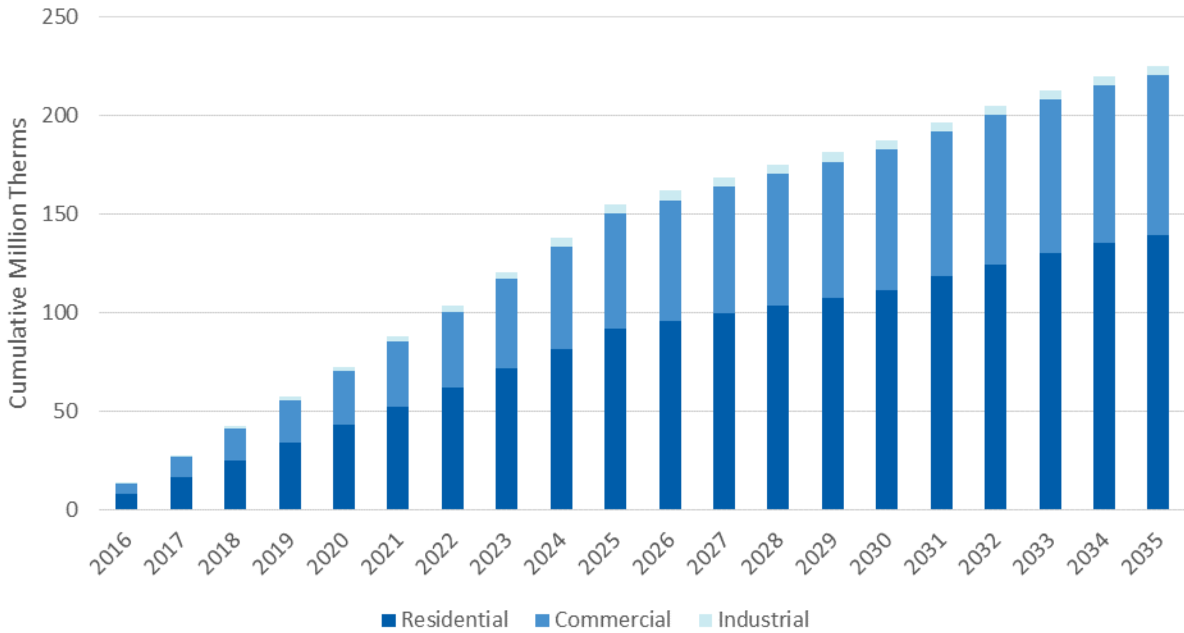
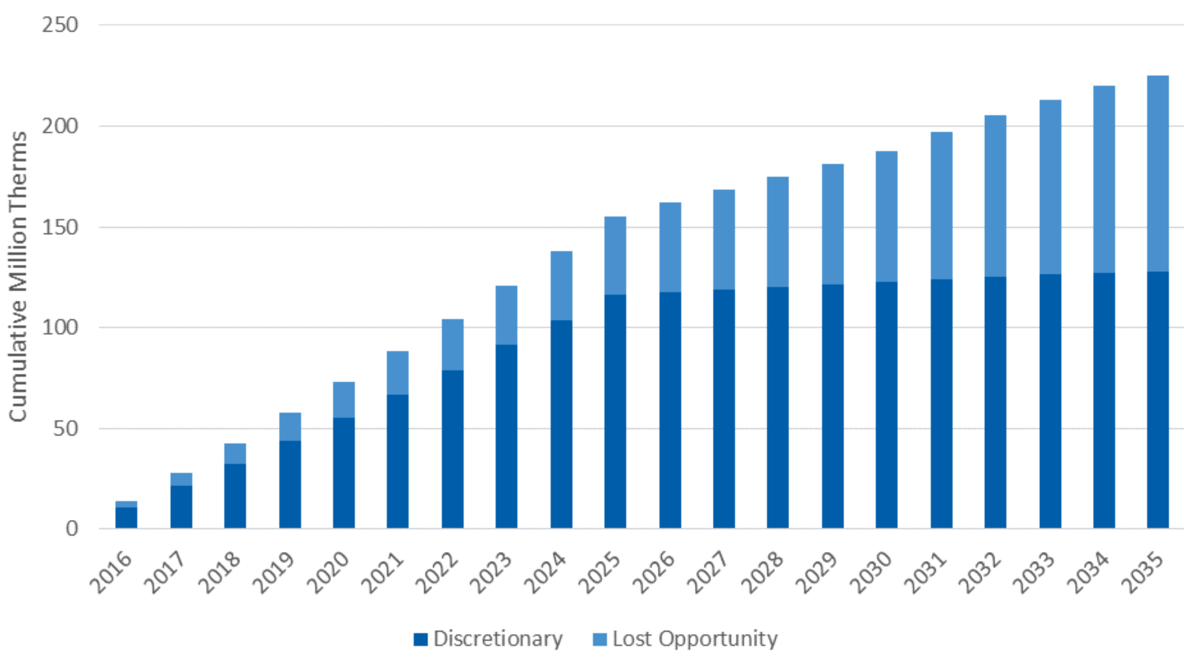


Figure 20 shows cumulative annual gas achievable technical potential by resource type (discretionary versus lost opportunity). In 2035, discretionary measures account for 57% of cumulative savings and lost opportunity measures account for the remaining 43%.

Figure 20. Gas Cumulative Annual Achievable Technical Potential by Resource Type



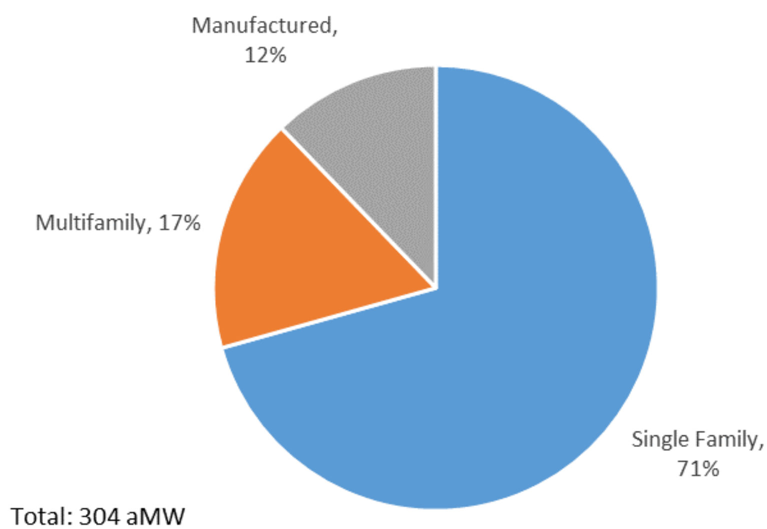
Detailed Resource Potentials

Residential Sector—Electric

By 2035, residential customers in PSE's service territory will likely account for nearly one-half of baseline electric retail sales. The single-family, manufactured, and multifamily dwellings comprising this sector present a variety of potential savings sources, including equipment efficiency upgrades (e.g., heat pumps, refrigerators), improvements to building shells (e.g., insulation, windows, air sealing), and increases in lighting efficiency (e.g., CFLs and LEDs). As described in the General Approach and Methodology section, the expected impacts of new lighting standards established through EISA have been removed from the potential presented in this section.

As shown in Figure 21, single-family homes represent 71% of the total achievable technical residential electric potential, followed by multifamily (17%) and manufactured homes (12%). Each home type's proportion of baseline sales is the primary driver of these results, but other factors such as heating fuel sources and equipment saturations play an important role in determining potential.

Figure 21. Residential Electric Achievable Technical Potential by Segment, Cumulative in 2035



For example, a higher percentage of manufactured homes use electric heat than do other home types, which increases their relative share of the potential. However, manufactured homes also tend to be smaller than detached single-family homes, *and* they experience lower per-customer energy; therefore, the same measure may save less in a manufactured home than in a single-family home. (Volume II, Appendix B.3 provides a comprehensive list of the factors impacting segment-level energy efficiency potential.)

Water heating end uses represent the largest portion (29%) of achievable technical potential. Heating, lighting, and appliances each also represent over 15% of the total identified potential. A considerable amount of energy efficiency potential remains in the lighting end use, even after EISA effects have been removed from the baseline forecast. Figure 22 shows the total achievable technical potential by end-use group. Table 16 presents detailed potentials by end use. (Volume II, Appendix B.3 provides additional details regarding the savings associated with the specific measures assessed within each end use.)

Figure 22. Residential Electric Achievable Technical Potential by End Use, Cumulative in 2035

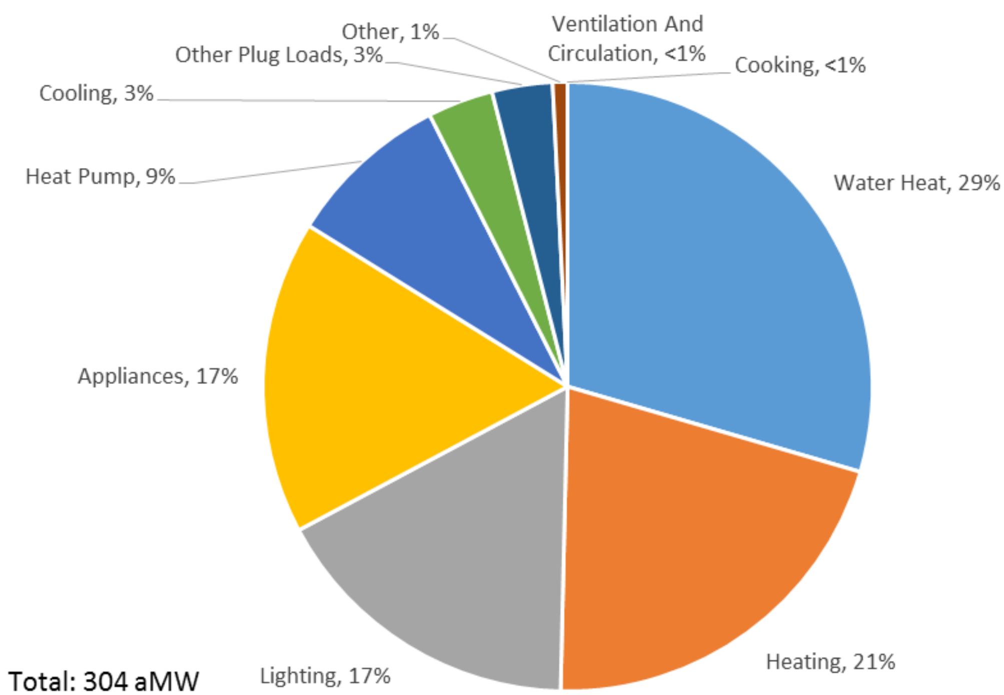
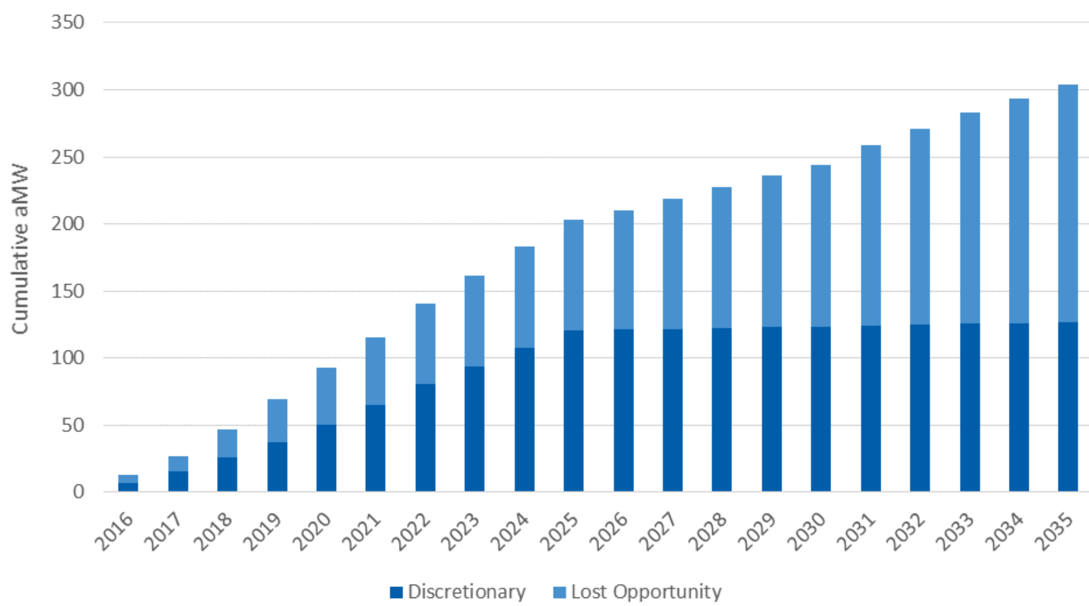


Table 16. Residential Electric Potential by End Use, Cumulative in 2035

End Use	Baseline Sales (aMW)	Technical Potential		Achievable Technical Potential	
		aMW	Percentage of Baseline Sales	aMW	Percentage of Baseline Sales
Appliances	207	67	32%	50	24%
Consumer Electronics	222	0	0%	0	0%
Cooking	17	0	1%	0	1%
Cooling	22	13	58%	11	49%
Heat Pump	84	35	42%	26	31%
Heating	213	78	37%	63	30%
Lighting	112	60	53%	51	45%
Other	6	3	54%	2	41%
Other Plug Loads	396	12	3%	10	2%
Plug Load	22	0	0%	0	0%
Ventilation And Circulation	77	3	4%	1	1%
Water Heat	237	119	50%	89	38%
Total Residential	**1,616**	**390**	**24%**	**304**	**19%**

Figure 23 shows annual cumulative achievable technical potential by resource type for the sector. Discretionary measures, acquired in equal increments over a 10-year period, account for 42% of the 20-year cumulative achievable technical potential. Lost opportunity measures account for the other 58% of the potential.

Figure 23. Residential Electric Annual Cumulative Achievable Technical Potential by Resource Type

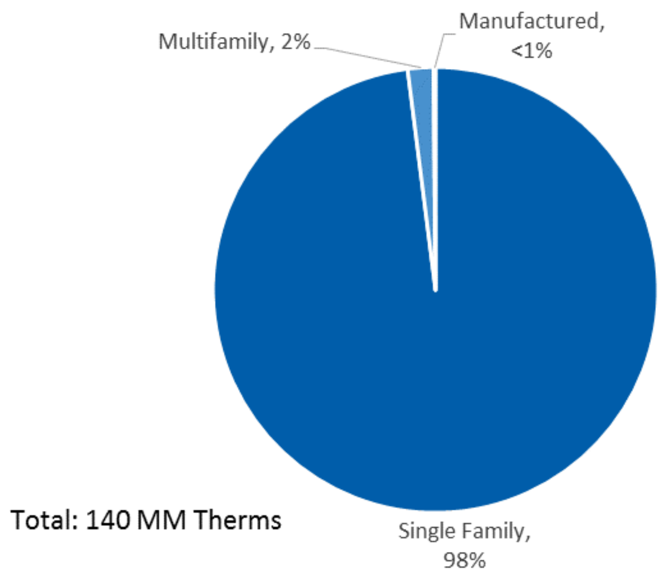


Residential Sector—Natural Gas

By 2035, residential customers will likely account for over 65% of PSE's natural gas sales. Unlike residential electricity consumption, there are relatively few natural gas-fired end uses (primarily space heating, water heating, and appliances); however, significant available energy savings opportunities remain. Based on the energy efficiency measures used in this assessment, achievable technical potential in the residential sector will likely provide about 140 million therms over 20 years, corresponding to a 17% reduction of forecasted 2035 sales.

Single-family homes account for 98% of the identified achievable technical potential, as shown in Figure 24. Less than 2% of total achievable technical potential occurs in multifamily and manufactured residences due to a lack of gas connections.

Figure 24. Residential Natural Gas Achievable Technical Potential by Segment, Cumulative in 2035



As shown in Figure 25, space heating and water heating end uses account for over 99% of the identified achievable technical potential, which combines high-efficiency equipment (such as condensing furnaces and water heaters) and retrofits (such as shell measures, duct and pipe insulation, and low-flow showerheads). Table 17 presents detailed potentials by end use.

Figure 25. Residential Natural Gas Achievable Technical Potential by End Use, Cumulative in 2035

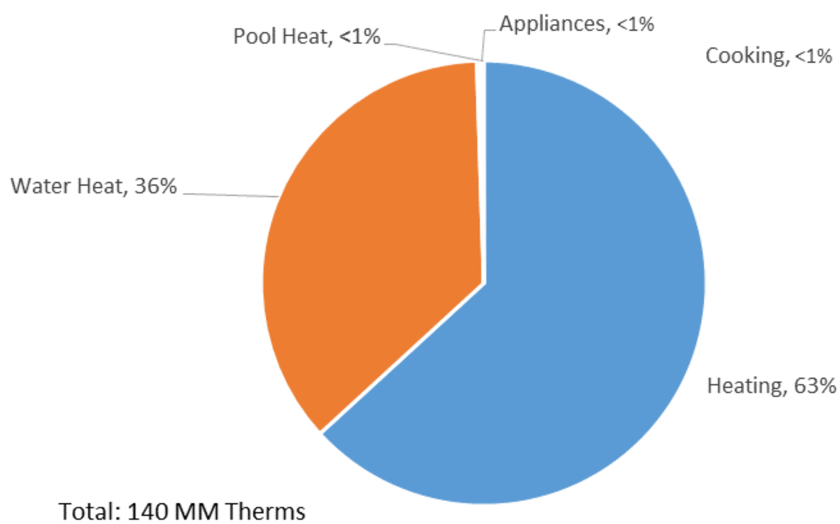
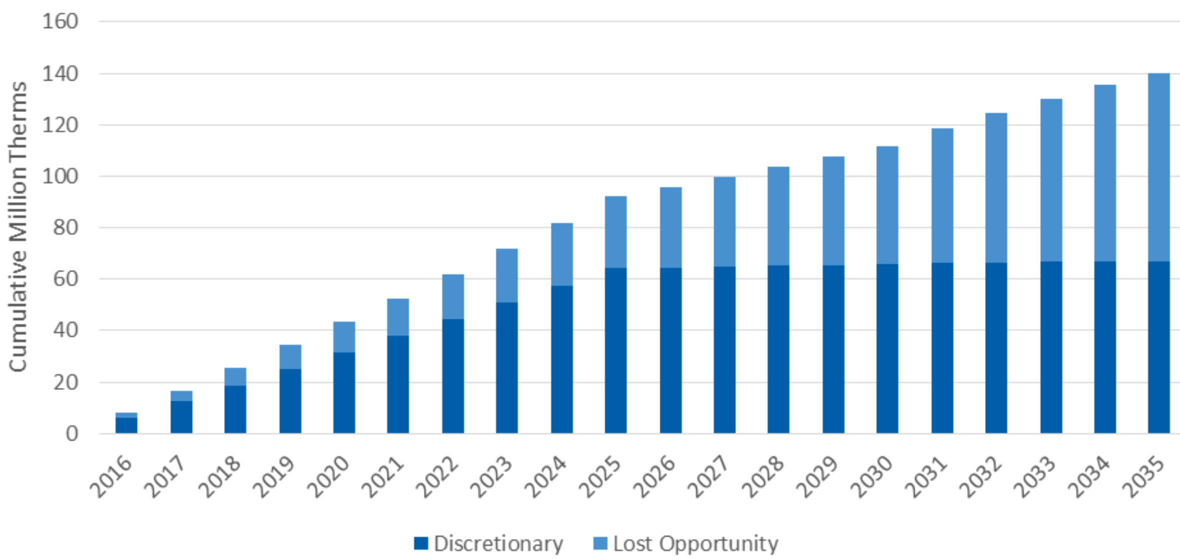


Table 17. Residential Natural Gas Potential by End Use, Cumulative in 2035

End Use	Baseline Sales (Million Therms)	Technical Potential		Achievable Technical Potential	
		Million Therms	Percentage of Baseline Sales	Million Therms	Percentage of Baseline Sales
Heating	535	139	26%	88	17%
Water Heat	178	77	43%	51	29%
Cooking	11	1	9%	0	3%
Appliances	3	0	9%	0	7%
Pool Heat	3	0	5%	0	4%
Total Residential	**730**	**217**	**30%**	**140**	**19%**

Figure 26 shows residential natural gas annual cumulative achievable technical potential by resource type. Discretionary measures, acquired in equal increments over a 10-year period, account for 48% of the 20-year cumulative, achievable technical potential.

Figure 26. Residential Natural Gas Annual Cumulative Achievable Technical Potential by Resource Type

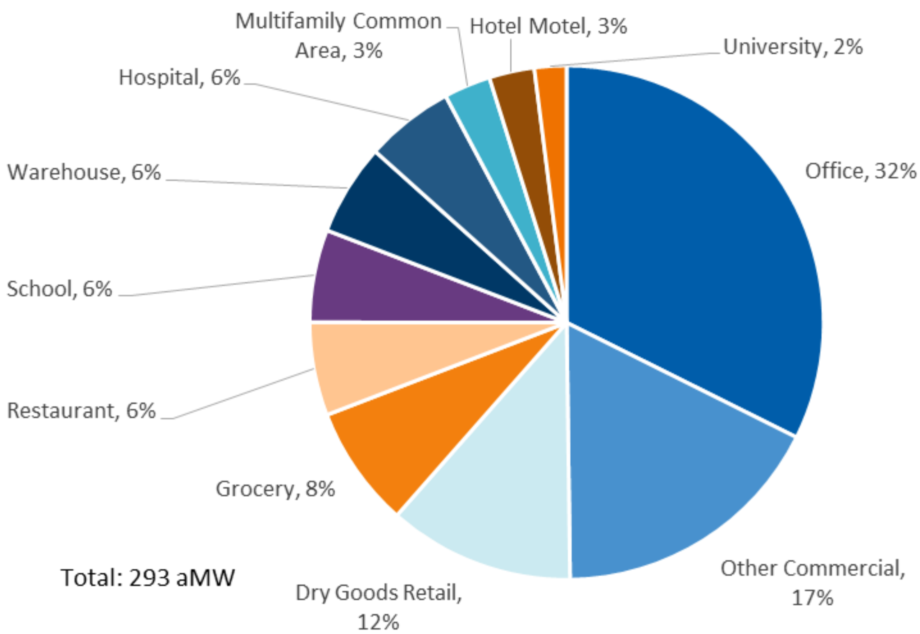


Commercial Sector—Electric

Based on resources included in this assessment, electric achievable technical potential in the commercial sector will likely be 293 aMW over 20 years, a 21% reduction in forecasted 2035 commercial sales.

As shown in Figure 27, offices represent slightly less than one-third (32%) of the available potential. “Other commercial” facilities also represent a large portion of available potential (17%). The other commercial segment includes customers not fitting into the other categories and customers with insufficient information for classification.

Figure 27. Commercial Electric Achievable Technical Potential by Segment, Cumulative in 2035



As shown in Figure 28, lighting efficiency improvements represent the largest portion by far of achievable technical potential in the commercial sector (48%), followed by ventilation and circulation (11%), cooling (9%), and refrigeration (8%). The large lighting potential includes bringing existing buildings to code and exceeding code in new and existing structures.

Table 18, which follows, shows distributions of baseline sales and savings across end uses.

Figure 28. Commercial Electric Achievable Technical Potential by End Use, Cumulative in 2035

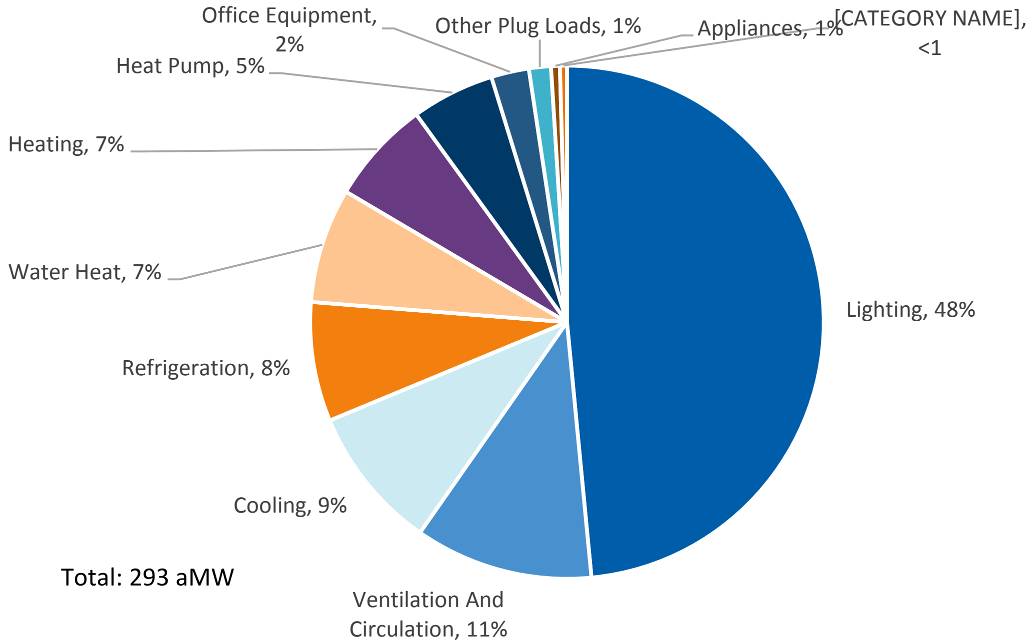
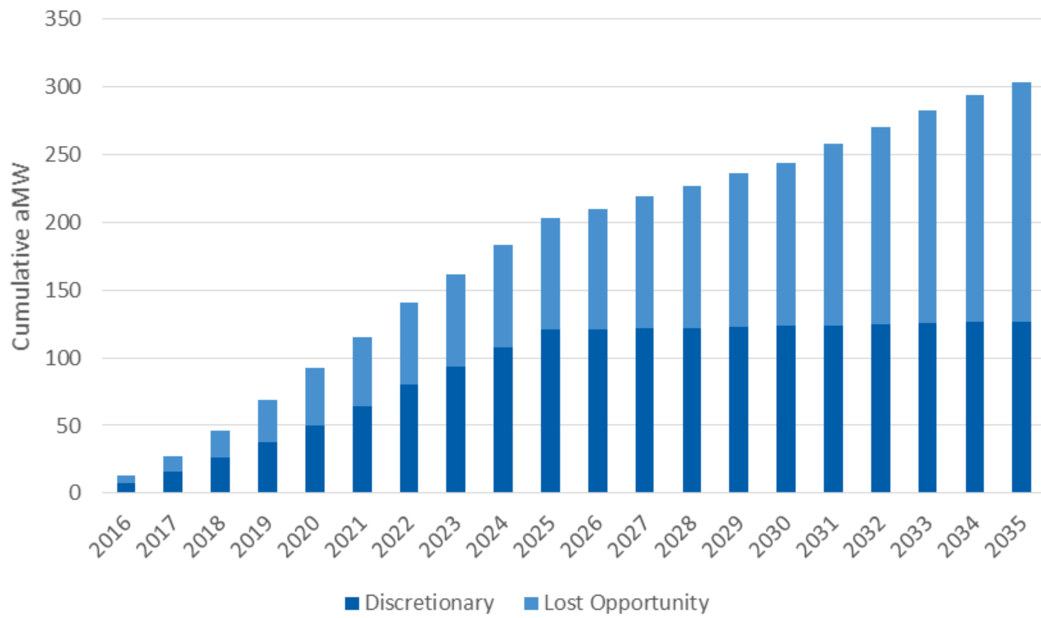


Table 18. Commercial Electric Potential by End Use, Cumulative in 2035

End Use	Baseline Sales (aMW)	Technical Potential		Achievable Technical Potential	
		aMW	Percentage of Baseline Sales	aMW	Percentage of Baseline Sales
Appliances	7	2	29%	2	25%
Consumer Electronics	1	0	0%	0	0%
Cooking	1	2	9%	1	8%
Cooling	17	32	42%	26	35%
Heat Pump	75	19	38%	15	30%
Heating	51	23	31%	19	26%
Lighting	73	171	25%	142	21%
Office Equipment	678	8	12%	7	10%
Other Plug Loads	67	5	6%	4	5%
Plug Loads	13	0	0%	0	0%
Refrigeration	74	26	35%	22	30%
Ventilation And Circulation	199	39	20%	33	17%
Water Heat	71	33	47%	21	30%
Total Commercial	**1,409**	**360**	**26%**	**293**	**21%**

Figure 29 shows commercial electric annual cumulative achievable technical potential by resource type. Discretionary measures, acquired in equal increments over a 10-year period, account for 42% of the 20-year cumulative achievable technical potential.

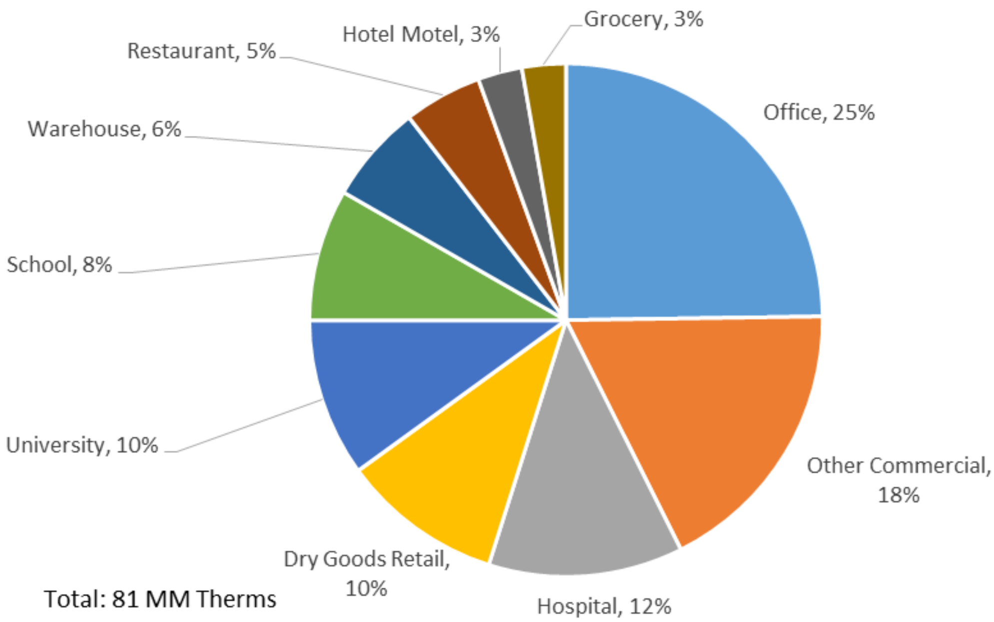
Figure 29. Commercial Electric Annual Cumulative Achievable Technical Potential by Resource Type



Commercial Sector—Natural Gas

Based on resources included in this assessment, natural gas achievable technical potential in the commercial sector will likely be 81 million therms over 20 years, an 18% reduction in forecasted 2035 commercial sales. Achievable technical natural gas potential in the commercial sector represents about 36% of the total identified potential across all sectors. As shown in Figure 30, for natural gas customers, office buildings represent the largest portion of potential (25%). Significant amounts of achievable technical potential exist in miscellaneous facilities (18%) and education buildings (18%).

Figure 30. Commercial Natural Gas Achievable Technical Potential by Segment, Cumulative in 2035



As in the residential sector, far fewer gas-fired end uses exist than electric end uses. Space heating accounts for 75% of the identified potential; the remaining potential is mostly in water heating (22%), with small amounts in cooking and pool heating (as shown in Figure 31 and Table 19).

Figure 31. Commercial Natural Gas Achievable Technical Potential by End Use, Cumulative in 2035

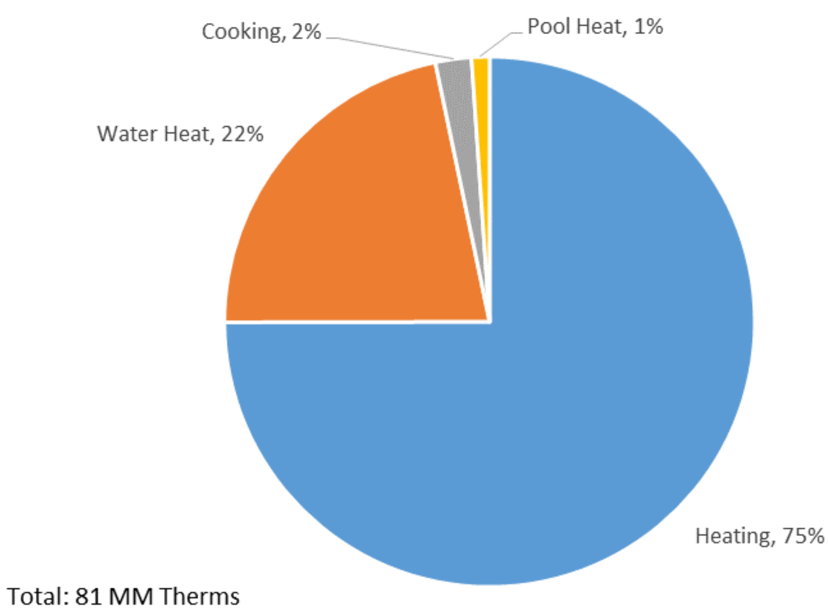
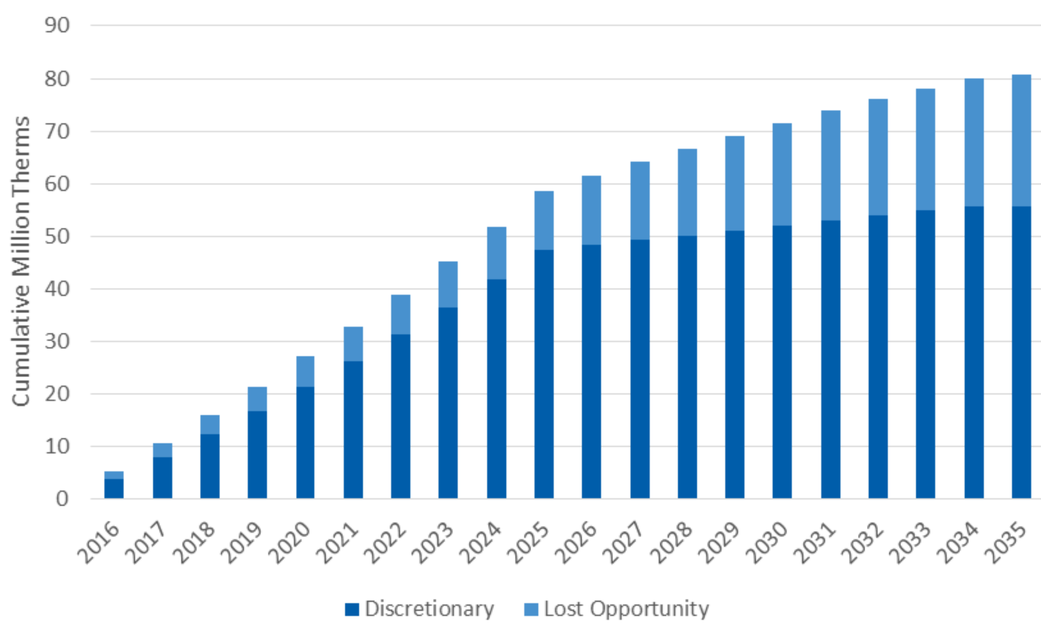


Table 19. Commercial Natural Gas Potential by End Use, Cumulative in 2035

End Use	Baseline Sales (Million Therms)	Technical Potential		Achievable Technical Potential	
		Million Therms	Percentage of Baseline Sales	Million Therms	Percentage of Baseline Sales
Heating	274	81	30%	61	22%
Water Heat	87	23	27%	18	20%
Cooking	62	2	4%	2	3%
Pool Heat	17	1	7%	1	5%
Total Commercial	**440**	**108**	**25%**	**81**	**18%**

Figure 32 shows commercial natural gas annual cumulative achievable technical potential by resource type. Discretionary measures, acquired in equal increments across a 10-year period, account for 69% of 20-year cumulative achievable technical potential.

Figure 32. Commercial Natural Gas Annual Cumulative Achievable Technical Potential by Resource Type

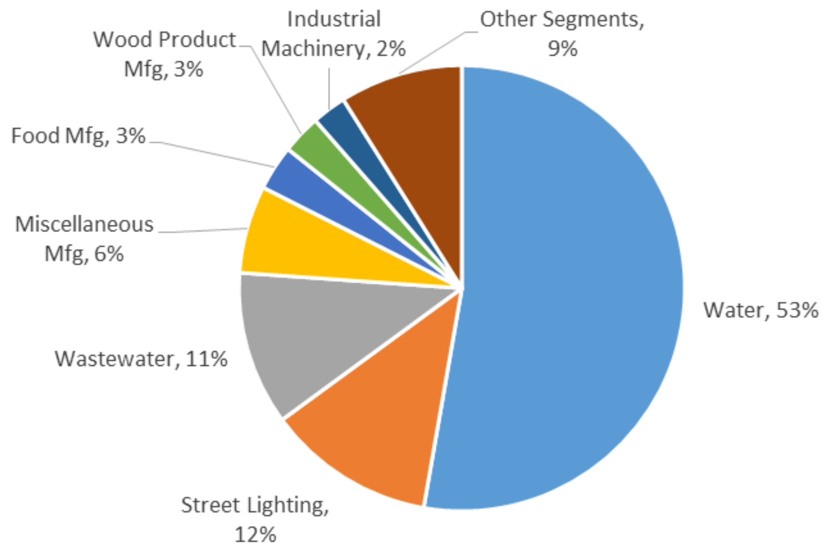


Industrial Sector—Electric

The study estimates technical and achievable technical energy efficiency potential for major end uses within 17 major industrial sectors. (Volume II, Appendix B.1. provides a list of these industries, along with baseline information.) Across all industries, achievable technical potential totals approximately 26 aMW over the 20-year planning horizon, corresponding to a 20% reduction of forecasted 2035 industrial consumption.

Figure 33 shows 20-year industrial achievable technical potential by segment.

Figure 33. Industrial Sector Electric Achievable Technical Potential by Segment



Other Segments includes Printing Related Support, Transportation Equipment Mfg, Fabricated Metal Products, Paper Mfg, Nonmetallic Mineral Products, Electrical Equipment Mfg, Plastics and Rubber Products, Chemical Mfg, Petroleum Coal Products, and Primary Metal Mfg.

As shown in Figure 34, the majority (52%) of electric achievable technical potentials in the industrial sector results from pumps. Street lighting measures (14%) and fans (13%) also comprise significant portions of available technical potential. A small amount of additional potential exists for lighting and other facility improvements. Table 20 presents detailed potentials by end use. All industrial measures should be considered discretionary, with savings acquired over a 10-year time frame.

Figure 34. Industrial Electric Achievable Technical Potential by End Use, Cumulative in 2035

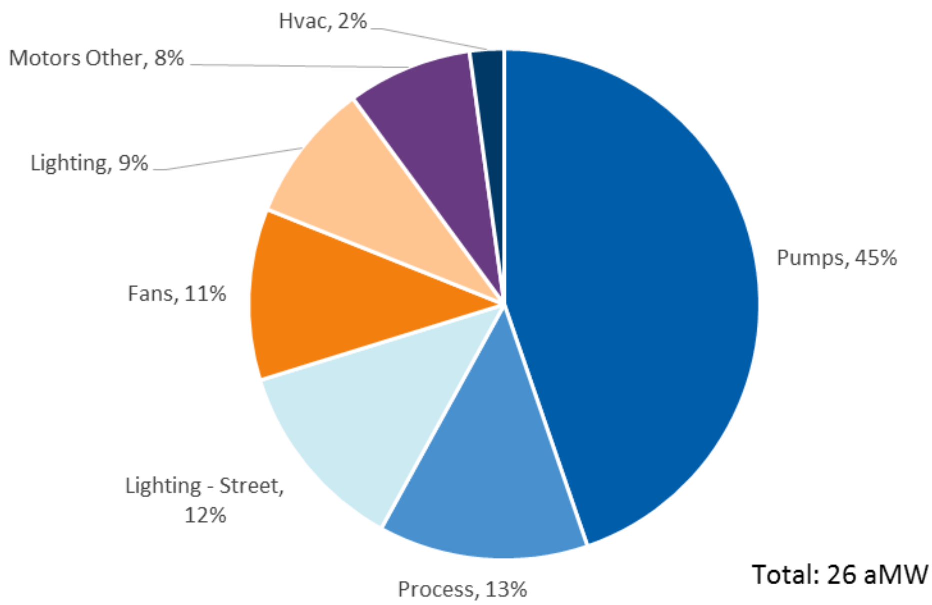


Table 20. Industrial Electric Potential by End Use, Cumulative in 2035

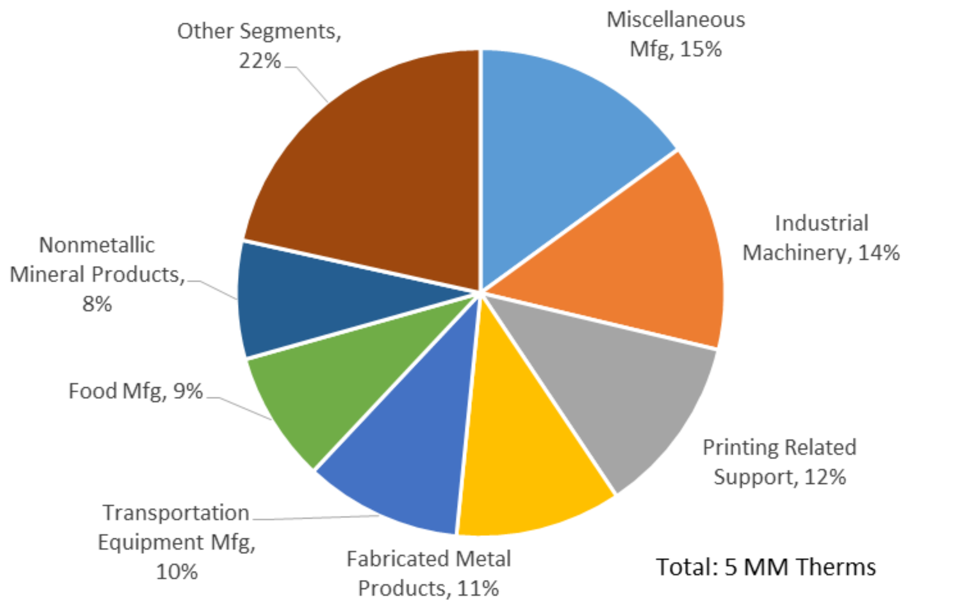
		Technical Potential		Achievable Technical Potential	
End Use	Baseline Sales (aMW)	aMW	Percentage of Baseline Sales	aMW	Percentage of Baseline Sales
Fans	9	3	38%	3	32%
HVAC	11	1	6%	1	5%
Indirect Boiler	1	0	0%	0	0%
Lighting	9	3	31%	2	27%
Lighting - Street	8	4	44%	3	37%
Motors Other	16	2	15%	2	12%
Other Plug Loads	11	0	0%	0	0%
Process	26	4	16%	3	13%
Pumps	39	14	35%	11	30%
Total	**129**	**30**	**23%**	**26**	**20%**

Industrial Sector—Natural Gas

Because electricity powers most industrial processes and end uses, the industrial sector represents a small portion of natural gas baseline sales and potential.

Across all industries, achievable technical potential totals approximately 5 million therms over 20 years. Although this represents 20% of forecasted 2035 industrial sales, it accounts for only 2% of the achievable technical potential across the three sectors. As shown in Figure 35, substantial achievable technical potential occurs in miscellaneous manufacturing (15%), machinery (14%), metals (11%), and transportation equipment manufacturing (10%).

Figure 35. Industrial Natural Gas Achievable Technical Potential by Segment, Cumulative in 2035



Other Segments includes Computer Electronic Mfg, Wood Product Mfg, Electrical Equipment Mfg, Plastics Rubber Products, Chemical Mfg, Primary Metal Mfg, Paper Mfg, Petroleum Coal Products, and Water/Wastewater.

Two-thirds of achievable technical potential derive from process improvements. As shown in Figure 36 and Table 21, the remaining potential occurs in HVAC and boiler improvements**.** All industrial measures should be considered discretionary, with savings acquired over a 10-year time frame.

Figure 36. Industrial Natural Gas Achievable Technical Potential by End Use

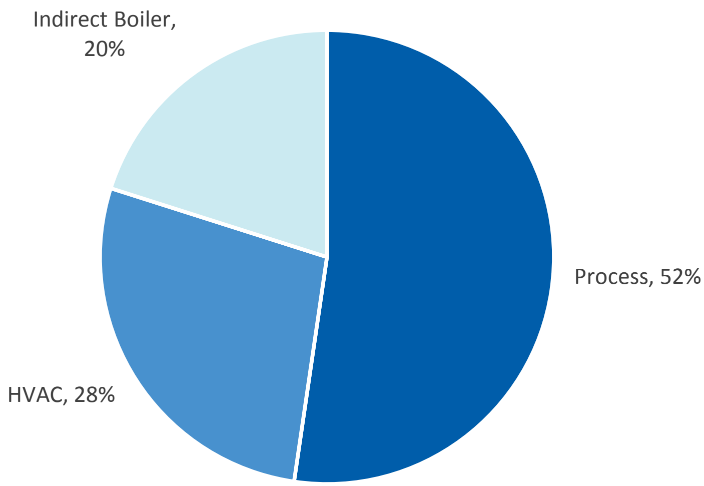


Table 21. Industrial Natural Gas Potential by End Use, Cumulative in 2035

End Use	Baseline Sales (Million Therms)	Technical Potential		Achievable Technical Potential	
		Million Therms	Percentage of Baseline Sales	Million Therms	Percentage of Baseline Sales
Process	10	3	33%	2	25%
HVAC	7	2	26%	1	20%
Indirect Boiler	6	1	19%	1	15%
Total Industrial	**23**	**6**	**27%**	**5**	**20%**

Fuel Conversion Potentials

Scope of Analysis

In the context of this assessment, fuel conversion refers to electricity-saving opportunities involving substitution of natural gas for electricity through replacement of space heating systems, water heating equipment, and appliances.

Where PSE provides both gas and electric service, this study examines fuel conversion potentials for existing residential single-family homes, existing and new commercial buildings, and new multifamily structures. Analysis includes three end uses for single-family and multifamily homes—space heating, water heating, and appliances (clothes dryers and cooking ranges). For new multifamily homes, the analysis includes the potential from converting electric baseboard heating to natural gas furnaces. For commercial buildings, the analysis examines only space and water heating end uses.

Summary of Resource Potentials

The calculations of fuel conversion technical potentials in this assessment assume conversion of all applicable customers and end uses.

As part of the 2009 IRP, Cadmus conducted a survey of residential customers that asked customers about their willingness to switch from an electric heating system to a gas heating system. Approximately 63% of respondents indicated they would be likely or highly likely to convert from electric to gas space heating if the utility paid 100% of the cost. With this result, we would assume the achievable technical potential to represent 63% of the technical potential. In the absence of comparable primary data, this analysis used the same percentage for the commercial sector.

Based on survey results and on previous PSE experiences, 70% of the new residential-sector gas customers converting a space heater would also convert a water heater and 5% would convert a range and/or dryer. For existing gas customers, all would convert a water heater and 5% would convert a range and/or dryer. The analysis assumes similar percentages for water heating conversions in the commercial sector.

Estimates indicate 207 aMW cumulative electric technical potential from fuel conversion by 2035. Acquisition of the indicated electricity savings will, however, result in increased gas consumption of about 15 million therms by 2035. After adjusting for the achievability described above, the total achievable technical electric savings potential of fuel conversion in 2035 is estimated at just over 57 aMW. This achievable technical potential corresponds to increased gas consumption of about 5 million therms.

Table 22 and Table 23 show, respectively, technical and achievable technical potential by customer type and market segment.

Table 22. Fuel Conversion Potentials by Customer Type, Cumulative in 2035

	Technical Potential		Achievable Technical Potential	
Customer Type	Electric Savings (aMW)	Additional Gas Usage (Million Therms)	Electric Savings (aMW)	Additional Gas Usage (Million Therms)
Electric - Only	159	11	45	4
Existing Gas Customer	63	4	16	1
Total	**222**	**15**	**61**	**5**

Table 23. Fuel Conversion Potentials by Market Segment, Cumulative in 2035

	Technical Potential		Achievable Technical Potential	
Market Segment	Electric Savings (aMW)	Additional Gas Usage (Million Therms)	Electric Savings (aMW)	Additional Gas Usage (Million Therms)
Single-Family	193	8	46	2
Multifamily	7	0	3	0
Commercial	22	6	11	3
Total	**222**	**15**	**61**	**5**

Detailed Resource Potentials

Residential Sector

The fuel conversion potential for single-family homes targets existing customers. The multifamily conversion targets both existing and new construction, with the new construction market size cumulative over 20 years, as estimated from PSE's customer forecast and assuming a consistent percentage of multifamily homes. The potential residential market size accounts for the current measure saturations. For example, some existing single-family homes already have a gas water heater, so these customers would not be considered for water heater conversion. In addition, the potential market size for new construction excludes the percentage of customers who have historically had gas systems.

Measures Considered

Cadmus' analysis of fuel conversion considers opportunities for three major end uses in residential dwellings—central heating, water heating (including conversion to integrated space and water heating units), and appliances (clothes dryer and oven). For space heating conversions, the study's treatment of multifamily homes differs slightly from single-family homes that use baseboard heating systems:

- For new multifamily buildings, the study examined conversion of room (or zonal) heating systems to natural gas furnaces.
- For existing single-family buildings, the study does not consider the cost of converting an existing baseboard system to a central system, given the high cost of installing the necessary ductwork.

Clothes dryers and cooking ranges were the only appliances considered in this study. Table 24 shows applicable measures and their assumed technical specifications. These measures are equivalent to those used for the Energy Efficiency section of this report, and detailed descriptions can be found in Volume II, Appendix B.

Table 24. End Uses and Measures Assessed

Segment	End Use	Gas Measure	Electric Baseline
MF, SF	Dryer	Dryer - Advanced Energy	Dryer - Federal Standard 2015
MF, SF	Cooking	Cooking Oven - Advanced Efficiency	Federal Standard 2012 Cooking Oven
MF, SF	Space Heating: Baseboard	Wall Heater 84% Efficiency	Electric Baseboard
MF, SF	Space Heating: Baseboard	Gas Fireplace	Electric Baseboard
MF, SF	Space Heating: Baseboard, Water Heating	Boiler	Baseboard Heating, Electric Water Heater, 55 gal.
MF, SF	Space Heating: Ducted	95% Furnace	Electric Furnace
MF, SF	Space Heating: Ducted, Water Heating	Integrated Space & Water Heat	Electric Furnace, Electric Water Heater, 55 gal.
MF, SF	Water Heating	WH (>67% EF)	Electric Water Heater, 55 gal.
MF, SF	Water Heating	Tankless WH	Electric Water Heater, 55 gal.
SF	Zone Heating: Baseboard	Wall Heater 84% Efficiency	Electric Baseboard

MF = multifamily, SF = single-family, WH = water heater, EF = energy factor

Gas Availability

In terms of service extension costs, gas availability and its implications are important considerations in determining the potential for fuel conversion. A major factor in determining the cost of new gas service is whether an electric-only customer is on a gas main. For existing single-family customers, the study used data from multiple sources (including PSE's 2010 RCS) to determine availability.[18]

PSE currently provides gas to approximately 49% of single-family homes in its electric service area. Customers currently receiving gas service from PSE can be considered candidates only for *additional* gas-using equipment, without imposing additional line extension costs. Using PSE's RCS to estimate the total number of gas-heated, single-family homes with electric water heaters and other appliances, Cadmus estimated over 45,000 existing gas homes were eligible for conversion.

Of electric customers without PSE gas service, approximately one-third reside in PSE's gas service territory. Based on the latest data available from PSE, approximately 24% of these customers are located on a gas main, 9% are a short distance (50 feet) from a gas main, and 18% are a moderate distance

18 Puget Sound Energy. *Residential Characteristic Survey.* 2010.

(200 feet) from a gas main. The remaining customers are too far from a gas main to be considered eligible for conversion.

For new electric multifamily customers, approximately 14% reside in PSE combination territory, with one-quarter on a main and one-quarter near a main. Of the customers within the combination territory, approximately 15% will install baseboard heating systems without programmatic intervention (and thus can be considered part of the conversion potential).

Conversion Costs and Savings

This study uses the total resource cost (TRC) approach to assess conversion costs. The TRC calculates the installed cost of the gas measure, less the cost of an equivalent electric measure, and includes gas line extension costs.

For electric-only customers, connecting a house to a gas main will probably require a service line extension that costs $3,406. Customers a short distance (50 feet) from a gas main experience would incur an additional $2,000 cost. Customers a moderate distance (200 feet) from a main would incur an additional $12,000 cost over the initial $3,406.

For this assessment, Cadmus analyzed the cost of line extensions for gas furnaces. However, because water heaters may be converted without the furnace, we included a proportional amount for water heating measures. An appliance end use would have an additional cost for interior piping (estimated at $200 per piece of equipment, according to local HVAC contractors in 2008).[19]

Figure 37 shows cumulative electric savings, categorized by home type and end use and distributed by levelized cost. We based these conversion savings estimates on the same assumed levels of unit energy consumption (UEC) as we used in the energy efficiency analysis (described in Energy Efficiency Potentials section). Calculation of levelized cost includes increased gas usage, which is counted as an ongoing annual O&M cost. For baseline values, the study uses electric UECs (kWh/year) and gas UECs (therms/year) from the baseline forecast for existing single-family and existing and new multifamily homes.

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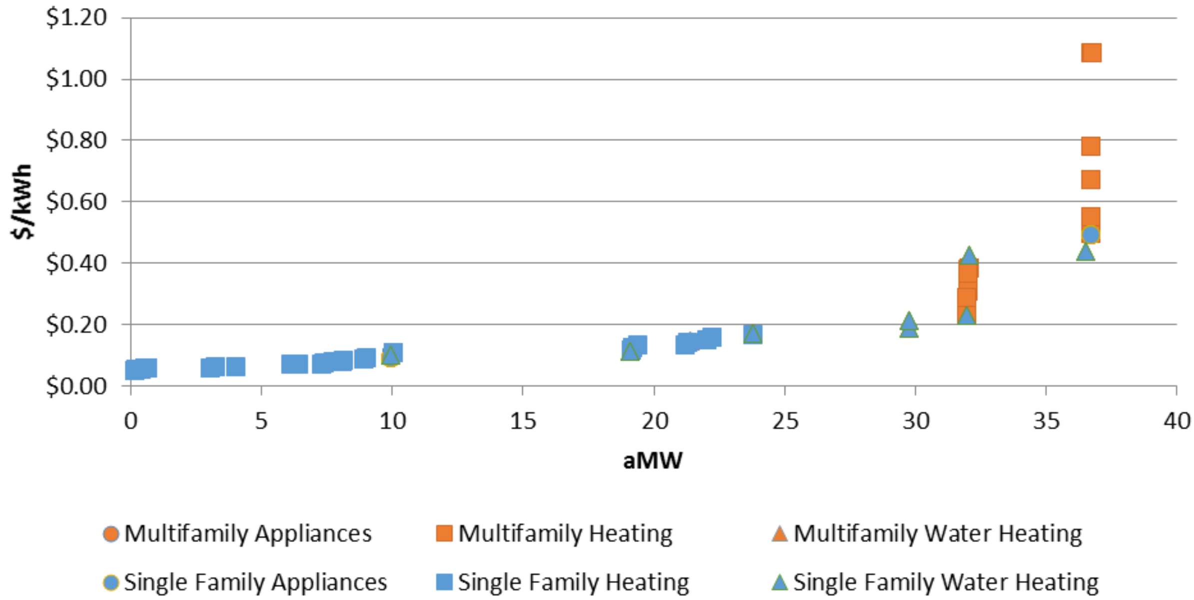
[19] Cadmus interviewed several HVAC contractors selected from PSE's Contract Referral Service List in 2008. Add complete source of Cadmus study.

Figure 37. Residential Fuel Conversion Supply Curve, Cumulative in 2035



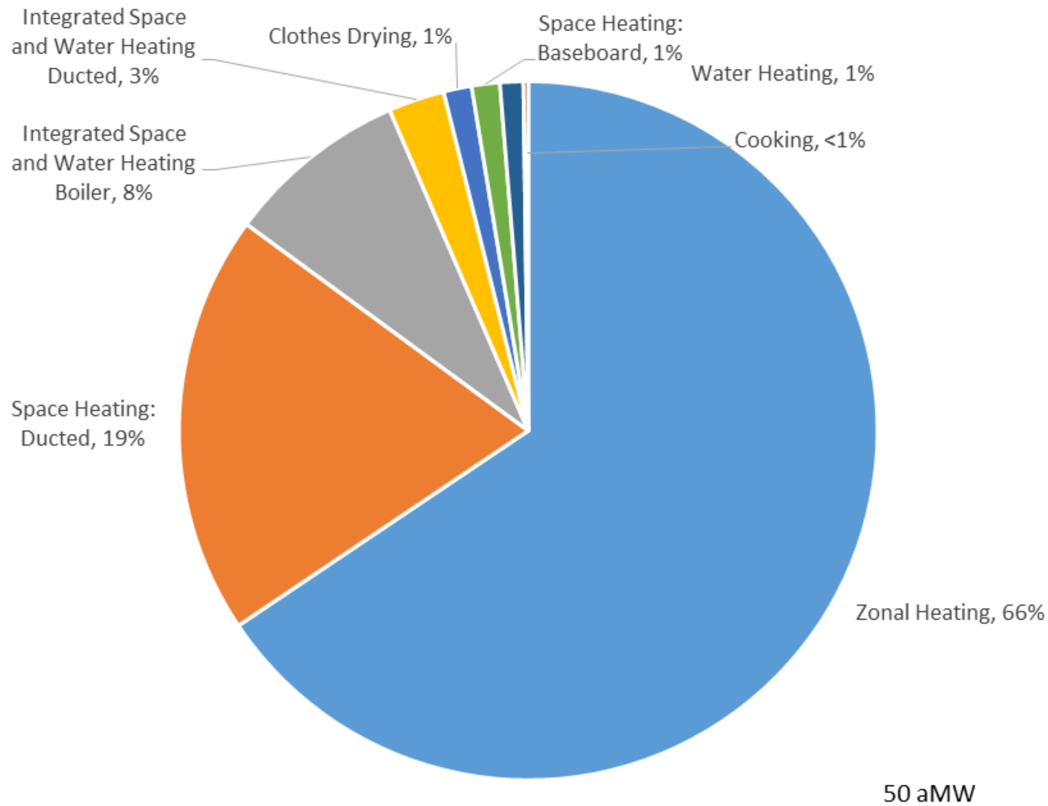
Potential

Table 25 and Figure 38 provide the technical and achievable technical conversion potential in 2035 for the residential sector (single-family and multifamily dwellings), by end use.

Table 25. Residential Fuel Conversion Potential by End Use, Cumulative aMW in 2035

End Use	Technical Potential	Achievable Technical Potential
Clothes Drying	20	1
Cooking	3	0
Space Heating: Baseboard	17	1
Integrated Space and Water Heating Boiler	13	4
Space Heating: Ducted	31	10
Integrated Space and Water Heating Ducted	42	1
Zonal Heating	59	33
Water Heating	16	1
Total	**200**	**50**

Figure 38. Residential Fuel Conversion Achievable Technical Potential by End Use, Cumulative 2035



Commercial Sector

The fuel conversion potential for the commercial sector includes conversion of equipment in existing buildings and new facilities.

Measures Considered

For existing facilities in the commercial sector, the measures considered include 95% AFUE furnaces and high-efficiency water heaters (≥0.67 EF storage and EF=0.82 tankless). The new construction segment includes the same measures, plus the additional measures provided in Table 26.

Table 26. New Construction Additional End Uses and Measures Assessed

Segment	End Use	Gas Measure	Electric Baseline

Segment	End Use	Gas Measure	Electric Baseline
All Com	Space Heating	Furnace - Premium Efficiency	Electric Furnace
All Com	Space Heating	Gas PACs	Packaged RTU
All Com	Space Heating, Water Heating	Integrated Space Heating and Water Heating	Packaged RTU, Electric Water Heater, 50 gal.
All Com	Space Heating, Water Heating	Integrated Space Heating and Water Heating	Packaged Rooftop VAV w/ Electrical Resistance Reheat & Electric Water Heater, 50 gal.
All Com	Space Heating: Ducted	Furnace - Premium Efficiency	Electric Furnace
All Com	Water Heating	ENERGY STAR Storage	Electric Water Heater, 50 gal.
All Com	Water Heating	ENERGY STAR Tankless	Electric Water Heater, 50 gal.

RTU = rooftop unit, VAV = variable air volume

Gas Availability

Data from the 2007 CBSA,[20] coupled with PSE's commercial customer database, provided market shares by territory and end use.

Of existing electric-only commercial customers, approximately 60% are in PSE gas territory, with around 25% of those on a main line. Expectations for new customers are approximately 32% within the combination service territory, 25% on a gas main, 9% a short distance (50 feet) from a gas main, and 18% a moderate distance (200 feet) from a gas main. The remaining customers will be too far from a gas main to be considered for conversion.

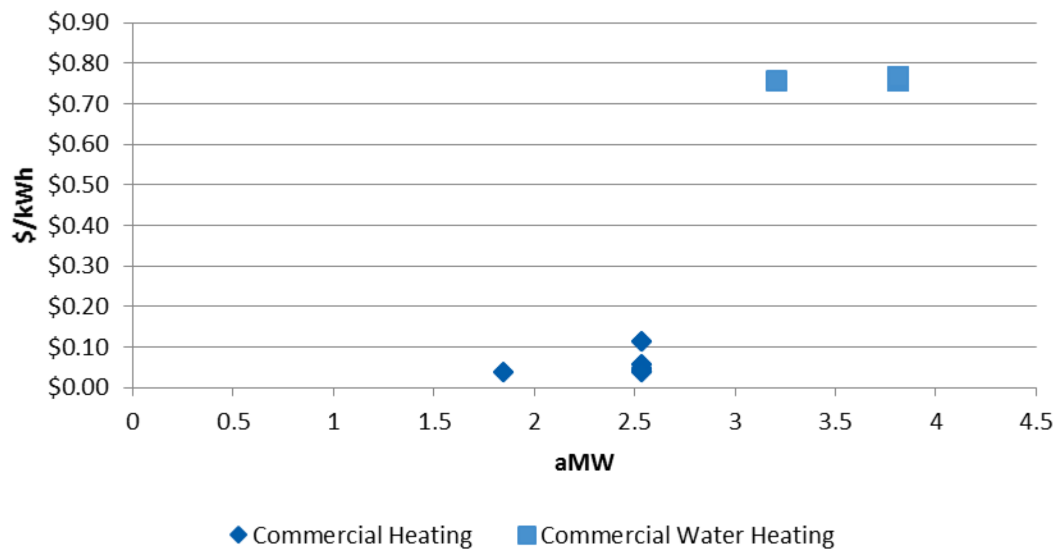
Conversion Costs and Benefits

The analysis estimates conversion savings based on assumed UEC levels, consistent with those used in the energy efficiency analysis described in the Energy Efficiency Potentials section. Increased gas use, counted as an ongoing annual O&M cost, is included in the calculation of levelized cost. For baseline values, the analysis uses electric UECs (kWh/year) and gas UECs (therms/year) from the baseline forecast.

Figure 39 shows cumulative electric savings, by end use, distributed by levelized cost. Similar to the residential sector, the service-line connection cost applies only to existing customers for the furnace cost. For simplicity, commercial buildings assume energy consumption as the weighted average of all segments, based on the likelihood of equipment being used in the given facility.

[20] Northwest Energy Efficiency Alliance. *2007 Commercial Building Stock Assessment (CBSA).* Available online: http://neea.org/resource-center/regional-data-resources/commercial-building-stock-assessment.

Figure 39. Commercial Fuel Conversion Supply Curve, Cumulative in 2035



Potential

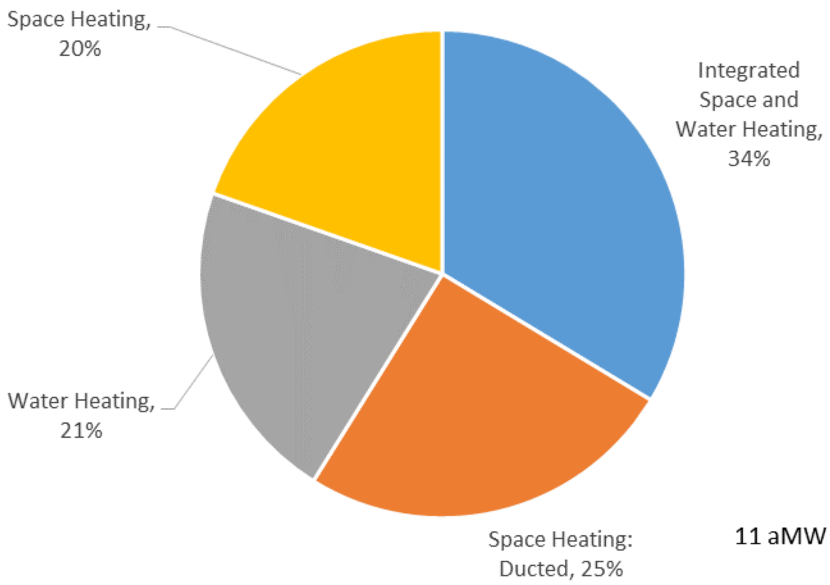
Table 27 and Figure 40 show the technical and achievable technical conversion potential in 2035 by end use.

Table 27. Commercial Fuel Conversion Potential by End Use, Cumulative aMW in 2035

End Use	Technical Potential	Achievable Technical Potential
Space Heating*	4	2
Space Heating: Ducted**	6	3
Integrated Space and Water Heating	6	4
Water Heating	5	2
Total	**22**	**11**

* Represents both furnace and gas warm-up heat conversions in new construction.
** Represents conversion for electric furnaces in existing buildings.

Figure 40. Commercial Fuel Conversion Achievable Technical Potential by End Use, Cumulative in 2035



Demand Response Potentials

Scope of Analysis

Focusing on reducing a utility's capacity needs, demand-response programs rely on flexible loads, which may be curtailed or interrupted during system emergencies or when wholesale market prices exceed the utility's supply cost. These programs seek to help reduce peak demand and promote improved system reliability. In some instances, the programs may defer investments in delivery and generation infrastructure.

Demand-response objectives may be met through a broad range of strategies, both price-based (such as time-varying rates or interruptible tariffs) and incentive-based (such as DLC) strategies. This assessment utilizes three demand response strategies:

- ***DLC*** programs allow a utility to interrupt or cycle electrical equipment and appliances remotely at a customer's facility. This study assesses DLC program potential for two programs in the residential sector:
  - A combination program of central electric heating (including heat pumps) and electric water heating; and
  - A combination program of room heating and electric water heating.
- ***Nonresidential Load Curtailment*** programs refer to contractual arrangements between a utility and a third-party aggregator that works with utility customers. The third-party aggregator typically guarantees a specific curtailment level during an event period, achieving load reduction by working with utility customers that agree to curtail or interrupt their loads in whole or part when requested. In most cases, customers must participate once enrolled in the program and incentives are paid per curtailed kW. Cadmus' analysis of these programs assumes they target nonresidential customers with average monthly loads greater than 100 kW. Customers may use backup generation to meet displaced loads.
- ***Critical Peak Pricing*** (CPP) or extreme-day pricing refers to programs aiming to reduce system demand by encouraging customers to reduce their loads for a limited number of hours during the year. When such events occur, customers may curtail their usage or pay substantially higher-than-standard retail rates. CPP programs integrate a pricing structure similar to a time-of-use (TOU) program, though CPPs use more extreme pricing signals during critical events. This assessment examines CPP options for both the residential and commercial sectors.

As this study updates the 2013 IRP, the program options listed above largely have been based on that assessment, with revisions based on PSE's input. After Cadmus reviewed new demand response literature including recent program evaluations on programs across the country as well as on PSE's pilot programs, updates were made to each program. This section details the design specifications and assumptions underlying the analysis for each program strategy.

Summary of Resource Potentials

Table 28 presents estimated resource potentials for all demand-response strategies for the residential, commercial, and industrial sectors during winter. The greatest market potential occurs in the residential sector, due to the DLC programs. Notably, this analysis does not account for program interactions and overlap; thus, the total market potential estimates may not be fully attainable upon implementation of all program strategies. The system peak is based on PSE's average load in the top 20 hours.

Table 28. Demand Response Market Potential, MW in 2035

Sector	Winter Market Potential (MW)	Percent of System Peak – Winter
Residential	115	2.9%
Commercial	62	1.6%
Industrial	5	0.1%
Total	181	4.5%

Resource Costs and Supply Curves

Resource acquisition costs fall into multiple categories, including infrastructure, administration, maintenance, data acquisition, hardware costs, marketing expenses, and incentives

Cadmus developed estimates for each expense category within each program using PSE's program data and experience, and using secondary sources, such as reports on similar programs offered by other utilities. In developing estimates of levelized costs, the study allocates program expenses annually over the program's expected life cycle, and discounts by PSE's cost of capital (7.77%). The ratio of this value and the discounted kW reduction produces the levelized per-kW cost for each program.

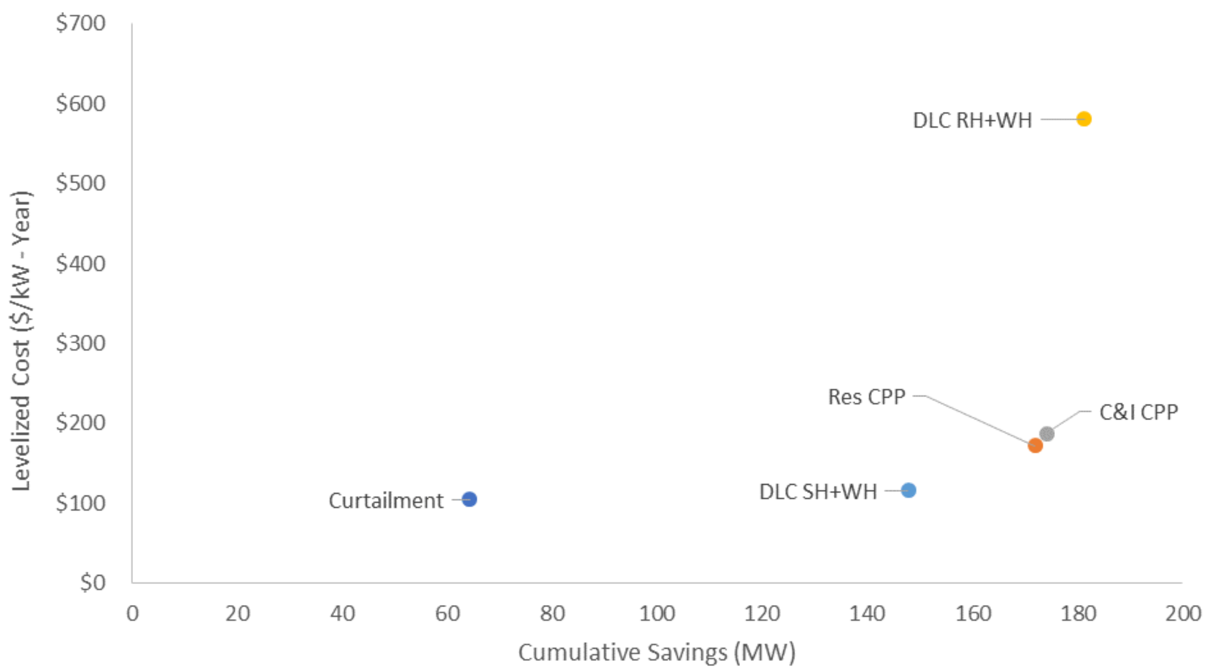
Table 29 displays per-unit ($/kW per year) costs by program for the estimated market potential during the winter season. Estimates find the Load Curtailment program for large, nonresidential customers to be the least-expensive option, with a levelized cost of $105/kW per year, while, due to high technology installation costs, the residential DLC—room and water heat program proves the most costly, with a levelized cost of $581/kW per year.

Table 29. Demand Response Market Potential and Levelized Costs, MW in 2035

Program Strategy	Achievable Potential (MW)	Levelized Cost ($/kW-year)
Residential Direct Load Control - Space and Water Heat	84	$115
Residential Direct Load Control - Room and Water Heat	7	$581
Residential Critical Peak Pricing	24	$172
Commercial & Industrial Critical Peak Pricing	2	$187
Commercial & Industrial Curtailment	64	$105
Total	**181**	

Cadmus constructed supply curves from quantities of estimated market potential and per-unit costs for each program option. Figure 41 shows the quantity of market demand-response potential available during winter peak hours in 2035 as a function of levelized cost.

Figure 41. 20-Year Achievable Supply Curve for Demand Response



Resource Acquisition Schedule

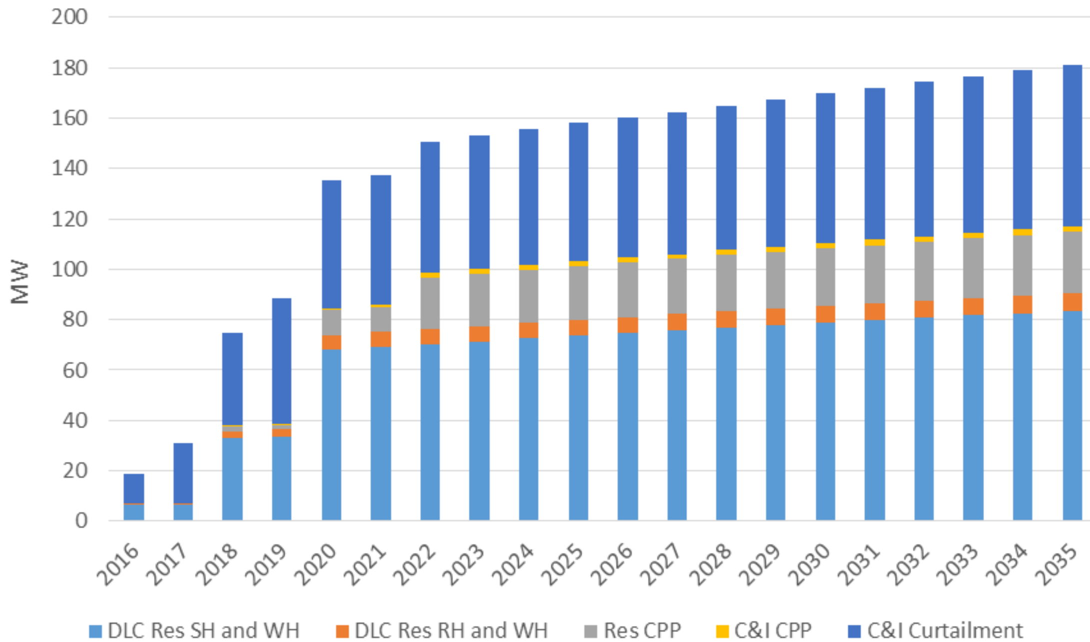
Cadmus assumes each program will require an ample start-up period before achieving full participation. Therefore, each program option has an associated ramp rate, as described here:[21]

- The curtailment program is assumed to begin in 2016 and reach maximum participation in 2019.
- Residential DLC programs and the Residential CPP program will start in 2016 as two-year pilot programs. In 2018, the programs will begin to grow to full participation by 2020. This schedule has been partially dictated by PSE's schedule for installing advanced metering infrastructure (AMI) in the residential sector.
- The CPP programs are assumed to start as a three-year pilot 2018 to account for the time required to create a new tariff and to place necessary infrastructure. In 2020, the programs will begin to ramp up, growing to full deployment by 2022.

Figure 42 shows the acquisition schedule for achievable potential impacts in winter.

21 Once programs reach full participation, impacts continue to grow due to forecasted load growth.

Figure 42. Demand Response Annual Achievable Technical Potential by Strategy - Winter



Detailed Resource Potentials by Program Strategy

Residential DLC

DLC programs seek to interrupt specific end-use loads at customer facilities through utility-directed control. When deemed necessary, the utility, through a third-party contractor, is authorized to cycle or shut off participating appliances or equipment for a limited number of hours on a limited number of occasions. Customers do not have to pay for the control equipment or installation costs, and they typically receive incentives, paid through monthly credits on their utility bills.

For such programs, load control switches or PCTs are connected to a digital internet gateway. Load control switches allow two-way communication enabling PSE to cycle end uses on and off during peak events, while PCTs automatically set-back temperature set points on heating and water heating systems. Historically, DLC programs have mandatory event participation once a customer elects to participate in the program; however, voluntary event participation has become an option for some programs where the control systems allow customers to opt-out or override their participation in an event once it has been called.

Because PSE's system peak occurs in the winter, this assessment focuses on two DLC programs controlling heating loads. Although residential DLC programs for air conditioning have become well-established programs in the nation, central and room heating DLC programs remain a relatively new idea, with minimal data available through secondary research. The winter peak limits program comparability to other summer peaking programs. However, lessons learned in summer peaking programs can inform PSE program participation and design.

PSE implemented a space-and-water-heating DLC pilot from 2009 through 2011. In addition to PSE's pilot program, there are several regional pilots Cadmus researched including the Bonneville Power Administration (BPA) Kootenai pilot, which included space heat and water heat; the BPA Orcas Power and Light Cooperative (OPALCO) pilot for water heat; and two Portland General Electric (PGE) pilots for space and water heat. Additionally, Minnesota commissioned a study of demand response potential and snapback effects including a space heating demand response program. Due to the minimal secondary data available for such programs, some summer DLC program assumptions have been adapted to supplement PSE's pilot data for this assessment.

Central Heating and Water Heating

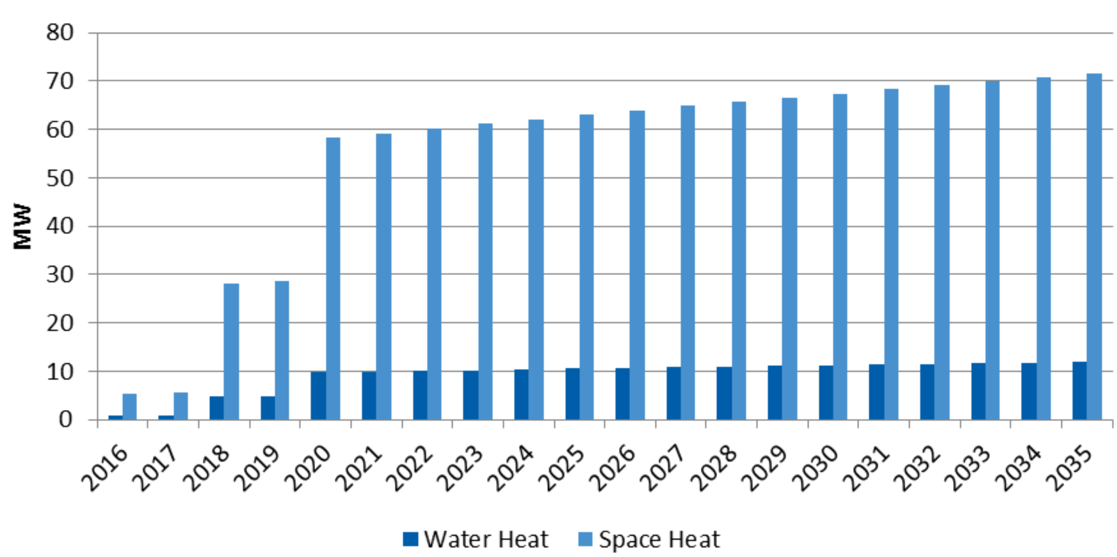
Table 30 shows the market potential results by end use and the levelized program cost. Although this program primarily focuses on reducing the winter peak, water heaters will be available for control in the summer.

Table 30. Space Heat Direct Load Control Results

End Use	Market Potential (MW 2035)	Percent of System Peak – Winter	Levelized Cost($/kW)
Central Heat	72	1.8%	$115
Water Heat	12	0.3%	
Total	84	2.1%	

Figure 43 shows the achievable potential over a 20-year period based on an acquisition schedule for a two-year pilot program, starting in 2016 and ramping up to full participation in 2020.

Figure 43. Space and Water Heat Direct Load Control Acquisition Schedule



Utility incentives for residential DLC programs can vary greatly, from a free programmable thermostat, to a set incentive amount per month, to a 15% discount on customers' summer electricity bills (which may range from $50 to $60 annually for many participants). This analysis assumes incentives set at $32/year for central heat cycling, with an additional $8 for water heating control. Program assumptions including attrition, event impacts, costs, incentives and participation are listed here:

- ***Attrition*** of 5% (program research ranges from 2% to 5%).
- ***Event impacts*** of 1.74 kW heating and 0.57 kW domestic water heater (DWH) from the pilot.
- ***Administration costs*** of 5%.
- ***Vendor costs*** of 15%.
- ***Technology costs*** of $280 per DHW switch, $370 per PCT, and $275 per gateway. These costs are based on PSE's pilot program and are inclusive of installation costs. (Program research ranged from $175/DWH switch to $600 for an installed PCT.)
- ***Marketing costs*** per customer are $25 based on 0.5 hours of a full-time employee (FTE), at $50 per hour, used in planning. Research ranged from $10 to $92, most of which were based upon FTE values; E Source benchmarking showed that marketing costs were equivalent to 9% of total program costs.[22]
- ***Incentive cost*** of $32 for each customers enrolled with the space heating program plus an additional $8 for customers who enroll in the water heater program (research ranges from $10 to $75).
- ***Communication costs*** of $7 per customer to account for the communication of a one-way transmission system.
- ***Program participation*** assumes that the program can reach 20% of eligible single-family and manufactured customers (program research ranged from 13% to 25%).
- ***Event participation*** of 94% (program research ranged from 70% room air conditioners to 95% for central air conditioners).

Room Heating and Water Heat Direct Load Control Results

Table 31 shows the market potential in winter at generation by end use and the levelized cost. Potential is much smaller for the room heating program compared to the space heating program because there is a lower saturation of room heaters and the per-participant impacts are also smaller. As with the central heating, greater potential exists in the winter, since the heating load occurs at that time.

Table 31. Room and Water Heat Direct Load Control Results

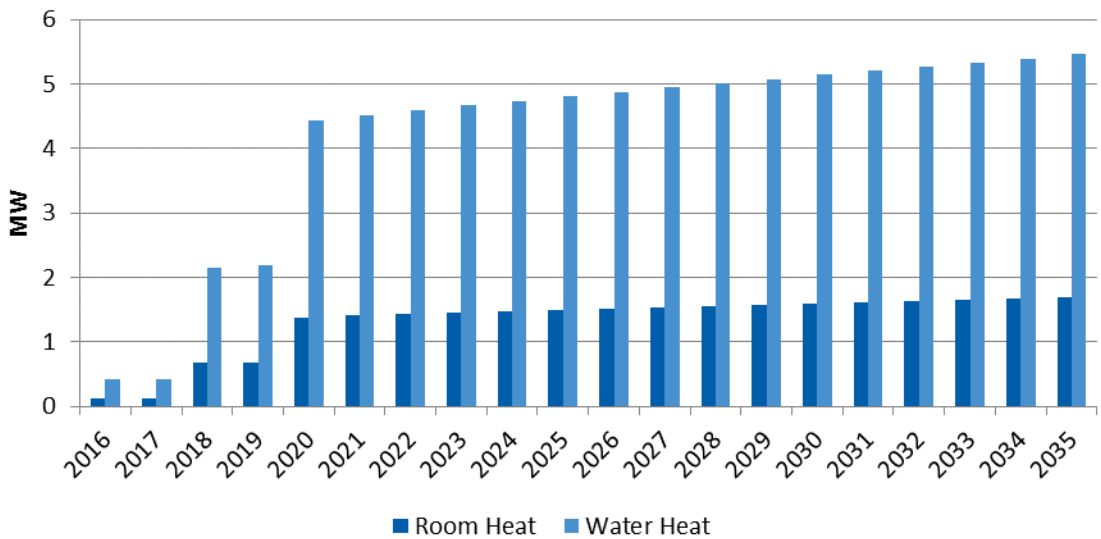
End Use	Market Potential (MW 2035)	Percent of System Peak – Winter	Levelized Cost($/kW)
Central Heat	2	0.1%	$581
Water Heat	5	0.1%	

[22] Nelson, Jonathan, and Rachel Reiss Buckley. *Hot or Not? DLC Program Benchmarking Results for the 2012 E Source Direct Load Control Program Study.* E Source Focus Report, EDRP-F-41. August 16, 2012.

End Use	Market Potential (MW 2035)	Percent of System Peak – Winter	Levelized Cost($/kW)
Total	7	0.2%	

Figure 44 shows the achievable potential over a 20-year period based on an acquisition schedule for a two-year pilot program, starting in 2016 and ramping up to full participation in 2020.

Figure 44. Room Heating and Water Heat Direct Load Control Acquisition Schedule



All cost assumptions remain consistent with the central heating program with the exception that each participant is assumed to have two room heaters controlled through the program. Program assumptions which differ from the room heat program include event impacts, technology costs (number of units) and program participation. Those assumptions are:

- ***Event impacts*** of 0.05 kW for room heating and 0.58 kW DWH from the pilot were used. Regional pilots had DWH of 0.65 kW to 0.69 kW for PGE and 0.45 to 0.50 kW for BPA OPALCO.[23]
- ***Technology costs*** of $280/baseboard heating switch and DWH switch and a $275 gateway cost.

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[23] Navigant Consulting Inc. *2011 EM&V Report for the Puget Sound Energy Residential Demand Response Pilot Program.* February 6, 2012.
Portland General Electric Company. *Direct Load Control Pilot: Pilot Evaluation and Impact Measurement.* October 22, 2004.
Portland General Electric Company. *Direct Load Control Pilot For Electric Space Heat: Pilot Evaluation and Impact Measurement.* October 22, 2004.
Cadmus, *Evaluation of OPALCO's Residential Demand Response Pilot.* Prepared for Bonneville Power Administration. 2013.

- ***Program participation*** assumes that program can reach 20% of eligible single-family and manufactured customers (program research ranged from 13% to 25%). It is assumed that each customer will have two room heaters enrolled through the program.

Nonresidential Load Curtailment

Load curtailment programs use contractual arrangements between the utility, a third-party aggregator that implements the program, and utility commercial customers who agree to curtail or interrupt their operations (in whole or part) for a predetermined period when requested by the utility. In most cases, mandatory participation or liquidated damage agreements are required once the customer enrolls in the program; however, the terms of each contract limit the number of curtailment requests—both in total and on a daily basis.

Generally, customers are not paid for individual events but receive compensation through a fixed monthly amount per kW of pledged curtailable load or through a rate discount. Typically, contracts require customers to curtail their connected load by a set percentage (typically from 15% to 20%) or a predetermined level (e.g., 100 kW). Such programs often involve long-term contracts, with penalties for noncompliance, which range from simply dropping the customer from the program to more punitive actions such as requiring the customer to repay the utility for the committed (but not curtailed) energy at market rates.

For this study, Cadmus assumes commercial customers with a monthly demand of at least 100 kW qualify for such a program. Backup generation plays a key role in potential savings associated with the curtailment program. Because these participants can turn on a backup generator during critical peak times, they experience minimal burdens. In many utility programs (excluding those in California), customers may use backup generators to meet curtailment requirements; this assessment includes such customers.

For aggregated curtailment programs, the burden to achieve the contracted savings at a set price is the aggregator's responsibility, reducing the role of PSE to administer the program. As such, Cadmus has relied on third-party aggregator pricing to inform the analysis.

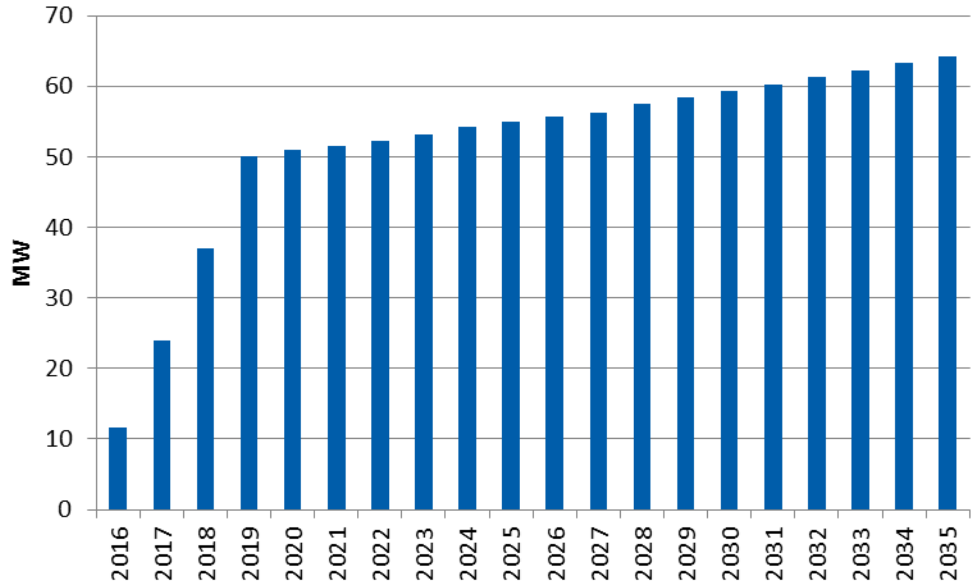
Table 32 shows the market potential at generation for the load curtailment program as well as the levelized cost.

Table 32. Load Curtailment Results

Program	Market Potential (MW 2035)	Percent of System Peak – Winter	Levelized Cost ($/kW)
Load Curtailment	64	1.6%	$105

Figure 45 shows the achievable potential over a 20-year period based on an acquisition schedule of 25% participation in 2016, ramping to full participation by 2019.

Figure 45. Load Curtailment Acquisition Schedule



Typically, curtailment programs run through third-party aggregators, which charge a set $/kW fee. This assessment considers utility administrative costs in addition to third-party aggregator costs. Detailed program assumptions, including values and sources from which potential and levelized costs have been derived are:

- ***Administration costs*** of 5% administrative costs are rolled into the $/kW cost.
- ***Technology costs*** are not applicable as included in third-party aggregator bid.
- ***Marketing costs*** are not applicable as included in third-party aggregator bid.
- ***Incentive cost*** are not applicable as included in third-party aggregator bid.
- ***Overhead costs*** are not applicable as included in third-party aggregator bid.
- ***Vendor Costs*** of $80/kW based on third-part aggregator bid.
- ***Event impacts*** assumes that customers will curtail approximately 30% of their load.
- ***Program participation*** – 20% of programs across the country are experiencing participation rates from 4% (the MidAmerican Curtailment Program has 4.5%) to 30% (Georgia Power and Indiana Michigan Power Company).[24]
- ***Event participation*** at 95%.

[24] MidAmerican study, Georgia Power study, Indiana Michigan Power Company study.

Critical Peak Pricing

Under a CPP program, customers receive a discount on their retail rates during non-critical peak periods in exchange for paying premium prices during critical peak events. The peak price, however, is determined in advance, providing customers with some degree of certainty about participation costs.

The program follows the basic rate structure of a TOU tariff, where the rate has fixed prices for usage during different blocks of time (typically on-, off-, and mid-peak prices by season). During CPP events, the normal peak price under a TOU rate structure is replaced with a much higher price, generally set to reflect the utility's avoided cost of supply during peak periods.

CPP rates only take effect for a limited number of times during the year. In times of emergency or high market prices, the utility can invoke a critical peak event, notifying customers that rates have become much higher than normal and encouraging customers to shed or shift load. Most CPP programs provide advanced notice in addition to event criteria (such as a threshold for forecasted weather temperatures) to help customers plan their operations. One attractive feature of the CPP program is the absence of a mandatory curtailment requirement.

A CPP rate offers a benefit over a standard TOU rate in that an extreme price signal can be sent to customers for a limited number of events. For several reasons, utilities have found typically greater demand reductions during these events than during TOU peak periods:

- Customers under CPP rates often use automated controls, triggered by a signal from the utility.
- The higher CPP rate serves as an incentive for customers to shift load away during the CPP event period.
- The relative rarity of CPP events may encourage short-term behavioral changes, resulting in reduced consumption during the events.

As the CPP rate only applies on select days, this raises a number of questions about when a utility can call an event, for how long, and how often. The rules governing utility dispatch of CPP events vary widely by utility and by program, with some utilities reserving the right to call an event at any time, while others must provide notice one day before the event. This analysis assumes five critical peak price events are called during winter with a duration of four hours, for a total of 40 event hours.

Table 33 shows the estimated market potential by sector for winter.

Table 33. CPP Technical and Achievable Technical Potential, MW in 2035

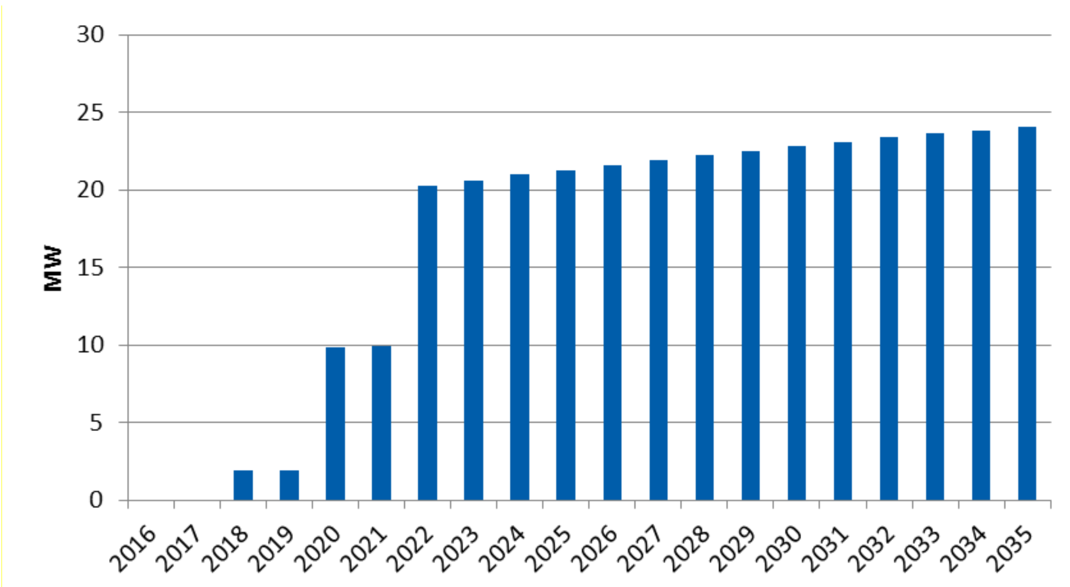
Sector	Market Potential (MW 2035)	Percent of System Peak – Winter	Levelized Cost ($/kW)
Residential	24	0.6%	$172
Commercial	2.1	0.1%	$187
Industrial	0.1	0.0%	
Total	**26**	**0.7%**	

Residential CPP

To develop potential estimates for PSE's CPP program, Cadmus relied on data from several CPP programs currently implemented across the nation. Critical peak pricing program studies have shown that 12% to 38% of peak demand can be reduced for participating customers depending upon program rate design and if enabling technology such as PCTs are combined integrated with the program. [25] Cadmus' study assumes a 12% load reduction with 10% participation and 100% event participation consistent with benchmarking of both fully implemented programs and pilot programs.

Figure 46 shows the market potential for the residential CPP program, based on an acquisition schedule that begins with a two-year pilot program in 2018, accounting for the time necessary to create a new tariff and to put AMI infrastructure in place. This will likely be followed by two years of increased participation, reaching full participation in 2022.

Figure 46. Residential CPP Acquisition Schedule



Residential Critical Peak Pricing Assumptions

Cadmus used these assumptions to analyze the residential CCP program.

- ***Administration costs*** of 15%.
- ***Technology costs (per new participant)*** of $220 for AMI and capital communication. AMI costs were in the range of $165 (Ameren) to $226 (FERC data).[26]

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[25] See benchmarking sources in programs assumptions below.

[26] Ameren Illinois. *Advanced Metering Infrastructure (AMI) Cost / Benefit Analysis.* June 2012. Federal Energy Regulatory Commission. *Assessment of Demand Response & Advanced Metering Staff Report.* October 2013.

- ***Marketing costs (per new participant)*** of $25 marketing costs are based on one-half hour of staff time valued at $50 per hour (fully loaded).
- ***Incentive cost (per participant)*** are not applicable as there are no customer incentives; customers may have a lower bill than they would have on a standard rate.
- ***Program startup costs*** of $400,000, assuming there are costs incurred for internal labor, research, and IT/billing system changes.
- ***Eligible Load (%)*** 100% as all residential customers are eligible.
- ***Technical Potential*** of 12% with current programs without enabling technology (PCTs). This is in the range of Green Mountain Power (11%) and Sioux Valley Energy (24%).[27,28]
- ***Program participation*** of 10%. SMUD pilot reached 5% of customers while OG&E reached 20% of customers during full implementation.[29,30]
- ***Event participation*** of 100% event participation, captured in the average load impact.

Nonresidential CPP

To develop potential estimates for PSE's CPP program, Cadmus relied on data from several CPP programs currently implemented. These data indicate generally low participation rates for commercial customers, ranging from 0.1% to 3.5% in California and OG&E achieved 2%. Therefore, Cadmus considers a 2% participation rate reasonable for PSE.

Figure 47 shows the market potential for the nonresidential CPP program, based on an acquisition schedule that begins with a two-year pilot program in 2018, accounting for the time necessary to create a new tariff and to put AMI infrastructure in place. This will likely be followed by two years of increased participation, reaching full participation in 2022.

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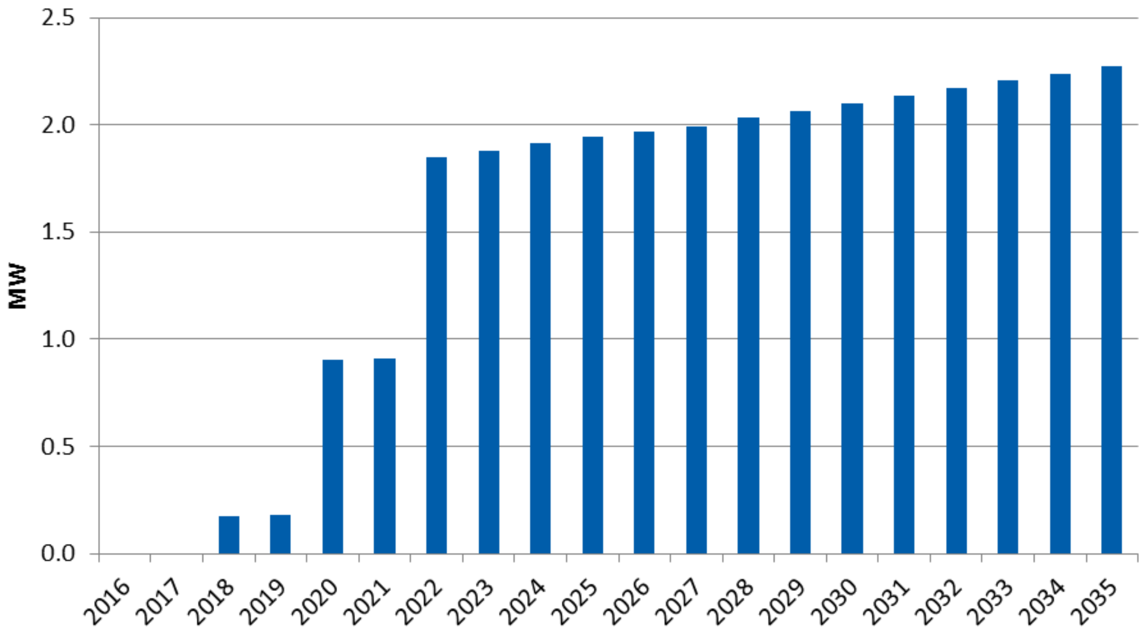
27 Blumsack, S., Hines, P. *Analysis of Green Mountain Power Critical Peak Events During the Summer/Fall of 2012*. Prepared for Green Mountain Power. November 19, 2013.

28 Power System Engineering, Inc. *EmPOWER Critical Peal Pricing Pilot Assessment*. Prepared for Sioux Valley Energy. March 12 2012.

29 SMUD. *SmartPricing Options Interim Evaluation.* Prepared for U.S. Department of Energy Lawrence Berkeley National Laboratory. October 23, 2013.

30 EnerNOC. *OG&E Smart Study Together Impact Results*. Prepared for OG&E. April 27, 2012.

Figure 47. Nonresidential CPP Acquisition Schedule



The residential CPP program has a start-up cost of $400,000, as a new rate structure will be put in place. Additionally, the program will require AMI and communications costs of $220 per participant. Marketing costs remain consistent with other program assumptions, and the program does not offer incentives due to its rate-based structure. Detailed assumptions of values and sources from which potential and levelized costs have been derived are listed below.

Commercial Critical Peak Pricing Assumptions

Cadmus used the following assumptions to analyze the commercial CCP program.

- ***Administration costs*** of 15%.
- ***Technology costs (per new participant)*** of $220 for AMI plus capital communication. AMI costs were in the range of $165 (Ameren) to $226 (FERC data).[31,32]
- ***Marketing costs (per new participant)*** of $500. Assumes 10 hours of effort by staff valued at $50 per hour. An additional hour per year is assumed for ongoing marketing and customer support.
- ***Incentive cost (per participant)*** is not applicable as there are no customer incentives; customers may have a lower bill than they would have on a standard rate.

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[31] Ameren Illinois. *Advanced Metering Infrastructure (AMI) Cost / Benefit Analysis*. June 2012.

[32] Federal Energy Regulatory Commission. *Assessment of Demand Response & Advanced Metering Staff Report.* October 2013.

- ***Program startup costs*** of $400,000, assuming there are costs incurred for internal labor, research, and IT/billing system changes.
- ***Eligible Load (%)*** as 100% of all C&I customers are eligible.
- ***Technical Potential*** of 5%. In 2011 load impacts ranged by utility; PG&E averaged 5.9%, SCE averaged 5.7%, and SDG&E averaged 5.8%.[33,34] In 2013, OG&E achieved 12%.[35]
- ***Program participation*** of 2%. Participation rates in an opt-in CPP program are typically low. In 2005, California experienced 1.1% participation rate across the state, which accounted for a total of 2.9% of peak load being enrolled.[36] Results for specific utilities include 3.5% for PG&E and 2% for OG&E.[37]
- ***Event participation*** of 100% event participation is captured in the average load impact.

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33 FSC Group. *2009 Load Impact Evaluation for Pacific Gas and Electric Company's Residential SmartRate Peak Day Pricing and TOU Tariffs and SmartAC Program*. Prepared for Pacific Gas and Electric Company. April 1, 2010.

34 FSC Group. *Southern California Edison's 2012 Demand Response Load Impact Evaluations Portfolio Summary*. Prepared for Southern California Edison. April 1, 2013. FSC Group. *2012 Ex Post and Ex Ante Load Impact Evaluation of San Diego Gas & Electric Company's Summer Saver Program and Peak Time Rebate Program for Summer Saver Customers.* Prepared for San Diego Gas & Electric Co. April 1, 2013.

35 EnerNOC. *OG&E Smart Study Together Impact Results.* Prepared for OG&E. April 27, 2012.

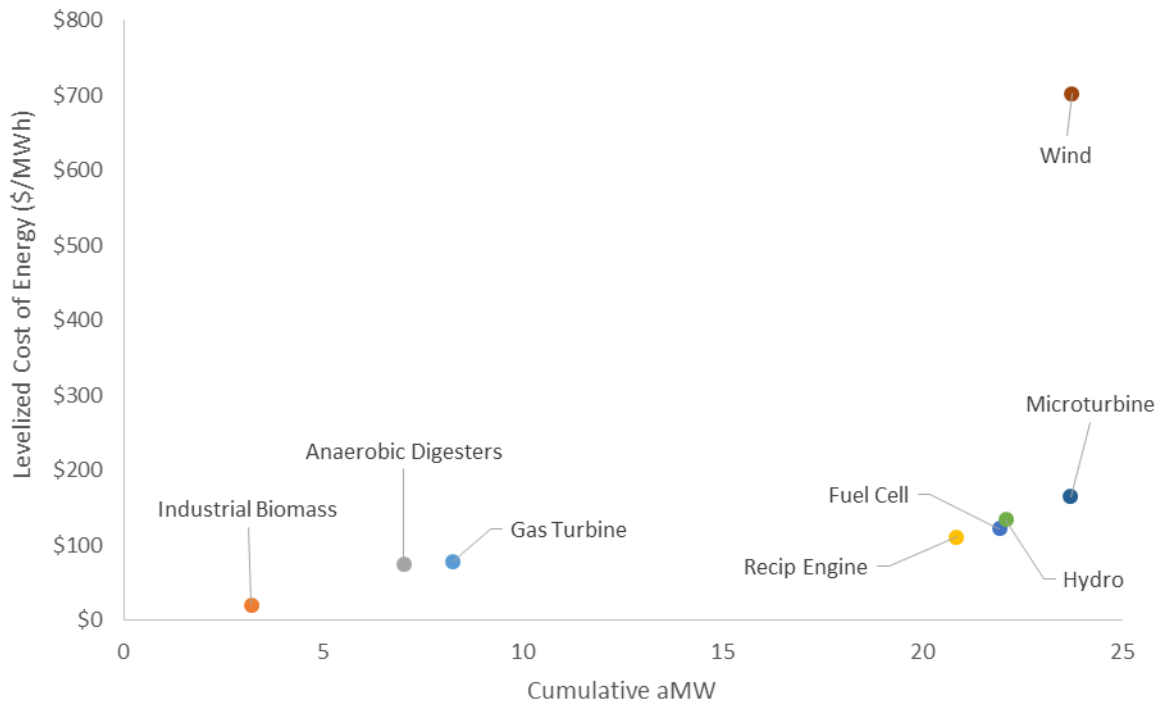
36 Study in California.

37 U.S. Energy Information Administration (EIA). *Annual Energy Outlook 2014 (AEO2014)*. Available online: http://www.eia.gov/forecasts/aeo/. Beck, R.W. *Distributed Renewable Energy Operating Impacts and Valuations Study*. 2009.

Distributed Generation

This study does not include estimations for distributed generation potentials. For detailed information regarding distributed generation potentials, see Cadmus' 2008 report.[38] We have, however, updated the costs of the distributed generation resources for this study, thus impacting the supply curves for PSE's 2015 IRP. Figure 48 illustrates the resulting supply curve.

Figure 48. 20-Year Achievable Supply Curve for Distributed Generation



The levelized cost of energy (LCOE) for many of the distributed generation technologies stayed constant or slightly decreased from the 2013 IRP to the 2015 IRP, as shown in Table 34. One exception was the small increase in levelized cost of small wind.

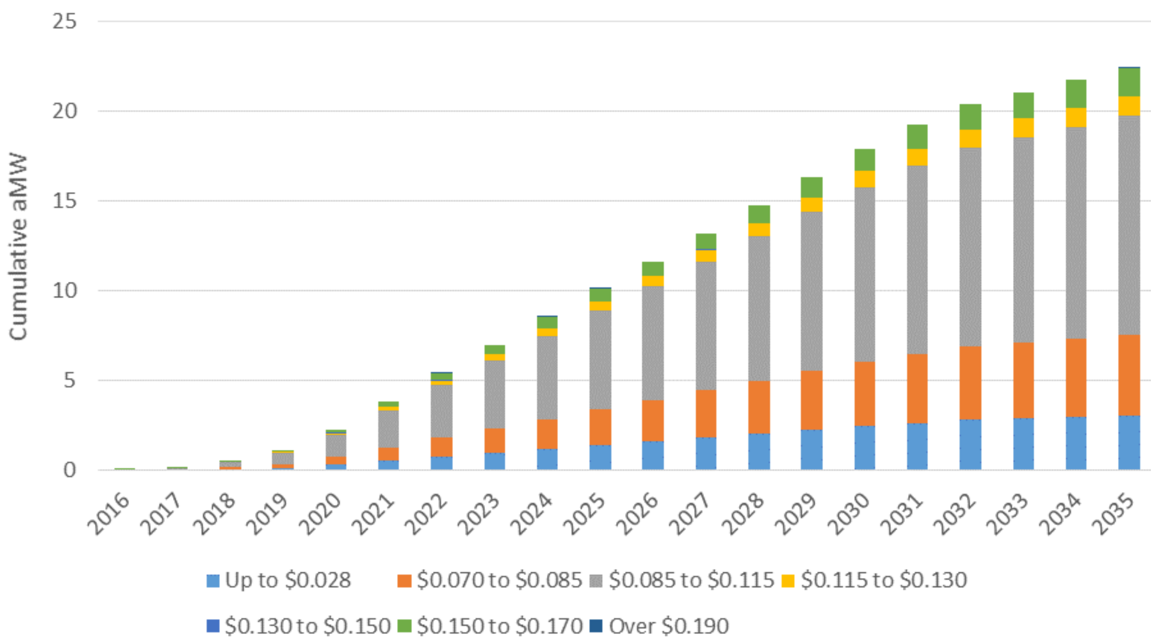
38 http://www.pse.com/SiteCollectionDocuments/2009IRP/AppL1_IRP09.pdf.

Table 34. A Comparison of the Levelized Cost of Energy Results from the 2013 IRP and 2015 IRP

Category	DG Technology	2013 IRP LCOE ($/kWh)	2015 IRP LCOE ($/kWh)
CHP - Renewable	Anaerobic Digesters	$0.08	$0.08
	Industrial Biomass	$0.02	$0.02
CHP - Non-renewable	Reciprocating Engine	$0.12	$0.11
	Micro turbine	$0.18	$0.16
	Fuel Cell	$0.12	$0.12
	Gas Turbine	$0.09	$0.08
Small Hydro	Hydro	$0.11	$0.13
Small Wind	Wind	$0.63	$0.70

Figure 49 shows the cumulative potential available in each year of this study, by levelized cost bundle.

Figure 49. Annual Achievable Distributed Generation Potential by Levelized Cost Bundle



CADMUS

Comprehensive Assessment of Demand-Side Resource Potentials (2016 – 2035): Appendices Volume II

August 15, 2015

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Appendix A. Methodological Consistency with the 6th Northwest Power Plan

To facilitate a comparison with the 6th Power Plan, the Council prepared an overview of the methodology used in developing the 6th Power Plan's conservation potential estimates. This appendix compares the methodology used in PSE's 2015 IRP to the benchmarks established by the Council.

Italics denote descriptions of methodologies used in this study.

Technical Resource Potential Assessment

The assessment reviewed a wide array of energy-efficiency technologies and practices across all sectors and major end uses.

The study considered measures from a variety of sources, including the 6th Plan, RTF, ENERGY STAR, and DEER. Appendix B.2 provides descriptions of all measures analyzed.

Methodology

- Technically feasibility savings = Number of applicable units * incremental savings/applicable unit
- "Applicable" units accounted for:
  - Fuel saturations (e.g., electric vs. gas DHW).

    Whenever possible, fuel saturations were based on data specific to PSE's service territory. PSE's 2010 Residential Energy Study (RES) and NEEA's 2008 Commercial Building Stock Assessment (CBSA) served as the primary sources of this information.

  - Building characteristics (e.g., single-family vs. mobile homes, basement/non-basement).

    Data derived from NEEA's 2011 Residential Building Stock Assessment (RBSA), RES, CBSA, and PSE billing information.

  - System saturations (e.g., heat pump vs. zonal, central AC vs. window AC).

    Whenever possible, system saturations were based on data specific to PSE's service territory. PSE's 2010 RES and NEEA's 2011 RBSA and 2008 CBSA served as the primary sources of this information.

  - Current measure saturations.

    Current saturations were incorporated into the applicability, based on information from the RES, RBSA, CBSA, the 6th Plan, RTF, and the experience of PSE conservation staff.

  - New and existing units.

    Existing and new units were calculated based on current and forecasted customers, respectively.

  - Measure life (stock turnover cycle).

Measure decay rates were applied to lost opportunity measures, based on measure life. Discretionary measures were assumed to be reinstalled at the end of their useful life.

- Measure substitutions (e.g., duct sealing of homes with forced-air resistance furnaces vs. conversion of homes to heat pumps with sealed ducts).

  The measure share applicability factor accounted for competition between measures to avoid double-counting.

- "Incremental" savings/applicable unit accounted for:
  - Expected kW and kWh savings, shaped by time-of-day, day of week and month of year.

    Energy and demand savings were either based on deemed values or calculated as a percent reduction in baseline end-use consumption. Hourly impacts were provided to PSE's IRP model.

  - Savings over baseline efficiency.

    Baseline set by codes/standards or current practices.

    Baselines were set based on current codes, standards, or current practices. Standards passed but not yet implemented became the baseline at the time mandated in the new standard.

    Not always equivalent to savings over "current use" (e.g., new refrigerator savings measured as "increment above current federal standards," not the refrigerator being replaced).

    Savings from equipment upgrades were calculated based on the minimum standard efficiency level available at the time of burnout.

  - Climate—heating, cooling degree days, and solar availability.

    Savings were based on the typical climate in PSE's service territory.

  - Measure interactions (e.g., lighting and HVAC, duct sealing and heat pump performance, heat pump conversion, and weatherization savings).

    These interactive effects were treated as a reduction in measure savings (e.g., commercial lighting measures might save less due to increased heating requirements).

Economic Potential: Ranking Based on Resource Valuation

- The total resource cost (TRC) served as the criterion for economic screening, and included all cost and benefits of measures, regardless of the parties paying for or receiving them.
  - TRC B/C Ratio > = 1.0

    Benefit-to-cost ratios were not calculated. Analysis used the levelized cost of conserved energy, as described below.

- Levelized cost of conserved energy (CCE) < levelized avoided cost for the load shape of the savings could substitute for TRC if "CCE" was adjusted to account for "non-kWh" benefits, including deferred T&D, non-energy benefits, environmental benefits, and the Act's 10% conservation credit.

  Levelized costs, on a TRC basis, were calculated for each measure in comparison with the Integrated Resource Planning's (IRP) supply-side resources. The levelized cost calculation incorporated deferred T&D (for electric resources), non-energy benefits, secondary fuel benefits, and the Act's 10% conservation credit (for electric resources).

Methodology

As valuation of energy and capacity savings was conducted in PSE's IRP model, it was not included as part of this study.

- The energy and capacity value (i.e., benefit) of savings was based on the avoided cost of future wholesale market purchases (forward price curves).
- The energy and capacity value accounted for the shape of savings (i.e., used time and seasonally differentiated avoided costs and measure savings).
- Uncertainties in future market prices were accounted for by performing the valuation under a wide range of future market price scenarios during the IRP process.
- Costs inputs (resource cost elements):

  All costs listed below were included in the per-unit measure costs, where appropriate.

  - Full incremental measure costs (material and labor).
  - Applicable ongoing O&M expenses (plus or minus).
  - Applicable periodic O&M expenses (plus or minus).
  - Utility administrative costs (e.g., program planning, marketing, delivery, ongoing administration, evaluation).
- Benefit inputs (resource value elements):

  All benefits listed below were assessed in calculating the levelized cost of conserved energy, where appropriate.

  - Direct energy savings.
  - Direct capacity savings.
  - Avoided T&D losses.
  - Deferral value of transmission and distribution system expansion (if applicable).
  - Non-energy benefits (e.g., water savings).
  - Environmental externalities.
- Discounted presented value inputs:

- Rate = After-tax average cost of capital weighted for project participants (real or nominal).

  The analysis used PSE's weighted average capital cost of 7.77%, nominal.

- Term = Project life; generally equivalent to life of resources added during the planning period.

  Costs were levelized over each measure's expected useful life. Any reinstallation costs over the 20-year planning period were similarly levelized.

- Money was discounted, not energy savings.

  The IRP analysis used this method.

Achievable Potential

- Annual acquisition targets, established through the IRP process (i.e., portfolio modeling).

  The results of the potentials assessment, bundled by levelized costs of conserved energy, were incorporated in the IRP model. Based on the value of savings, the IRP model selected the appropriate amount of conservation.

- Conservation competed against all other resource options in portfolio analysis:

  Conservation resource supply curves separated into:

  - Discretionary (non-lost opportunity).

    Defined as retrofit opportunities in existing facilities.

  - Lost-opportunity.

    Including equipment replacements in existing facilities and all new construction measures.

  - Annual achievable potential, constrained by historic "ramp rates" for discretionary and lost-opportunity resources:

    The maximum ramp-up/ramp-down rate for discretionary was 3x the prior year for discretionary, with an upper limit of 85% over the 20-year planning period.

    Analysis assumed 85% of discretionary resources could be acquired within a 10-year timeframe.

    The ramp rate for a lost-opportunity was 15% in first year, growing to 85% by the 12th year.

    Lost opportunity ramp rates varied by measure, and were based on the assumptions used in the 6th Plan.

    Achievable potentials could vary by the type of measure, customer sector, and program design (e.g., measures subject to federal standards could have 100% "achievable" potential).

While the analysis removed savings from known standards, it did not attempt to predict which savings would be acquired from future codes or standards.

- Revised technical, economic and achievable potential, based on changes in market conditions (e.g., revised codes or standards), program accomplishments, evaluations, and experience.

  Changes taking effect after the finalization of the 2015 IRP will be reflected in the 2017 IRP.

  - All programs should incorporate Measurement and Verification (M&V) plans that, at a minimum, track administrative and measure costs and savings.
  - The International Performance Measurement and Verification Protocols (IPMVP) should be used as a guide.

Appendix B.1: Detailed Results

The following graphs shows baseline electric and gas forecasts by sector and segment. The following table show assumptions of gas and electric equipment, fuel shares, annual per unit energy consumption for residential end uses, and annual per square foot energy consumption for commercial end uses.

Figure B-1.1 Residential Electric Baseline Forecast 2015-2035

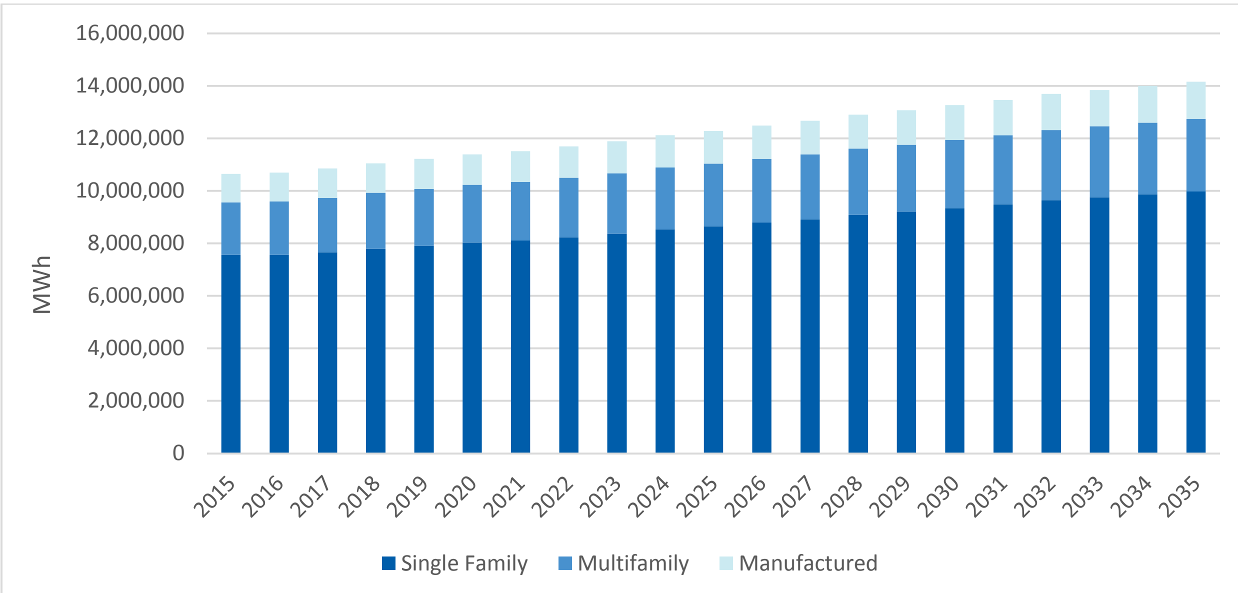

Figure B-1.2 Commercial Electric Baseline Forecast 2015-2035

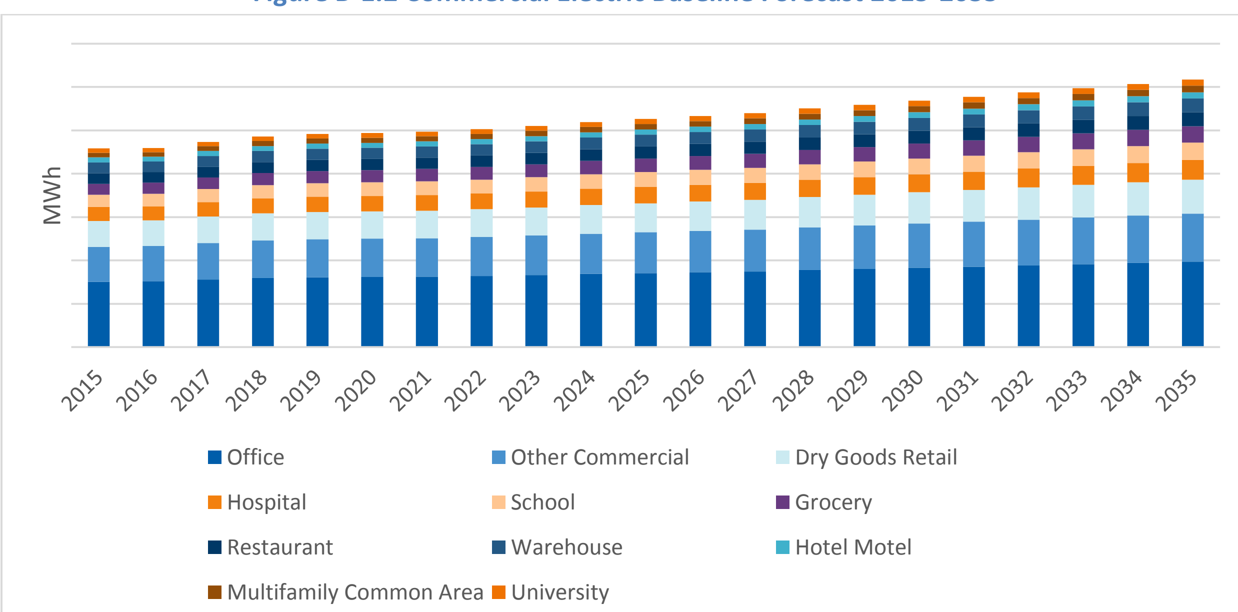

Figure B-1.3 Industrial Electric Baseline Forecast 2015-2035

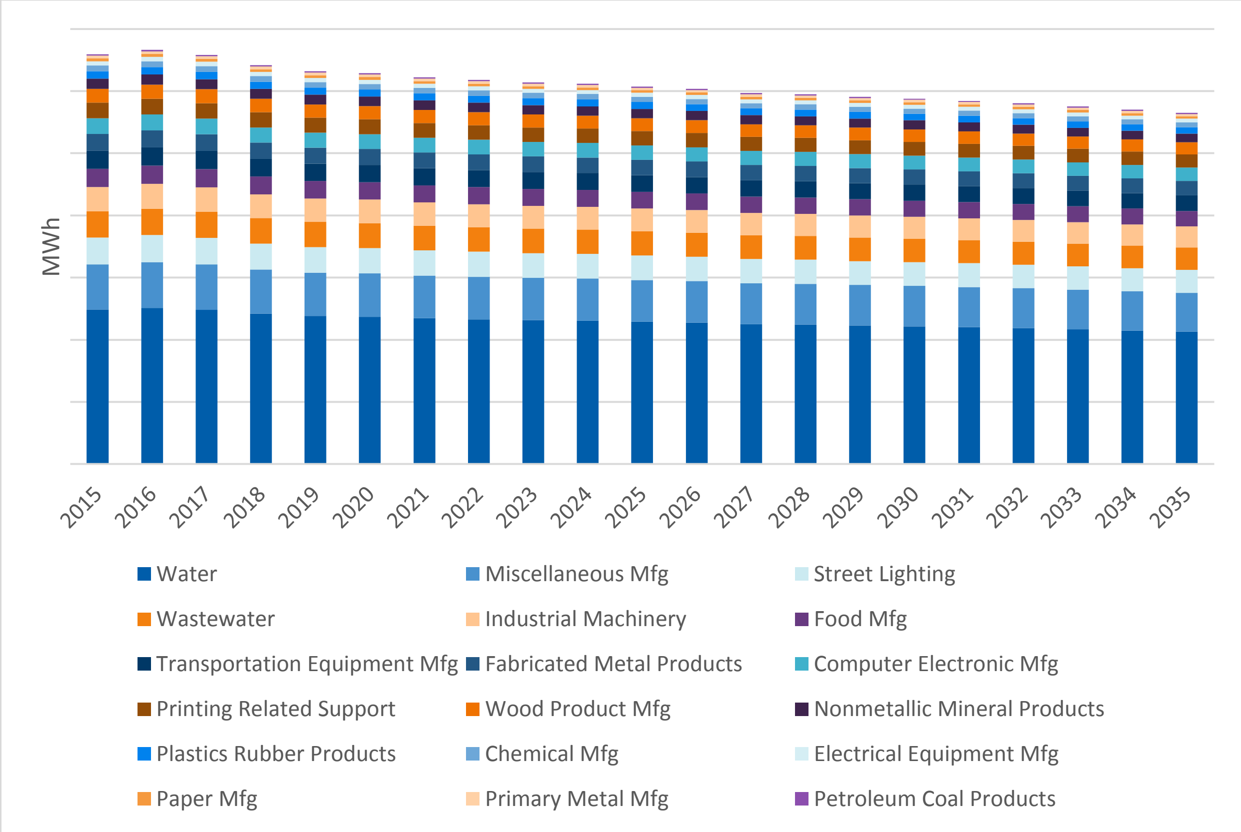

Figure B-1.4 Residential Gas Baseline Forecast 2015-2035

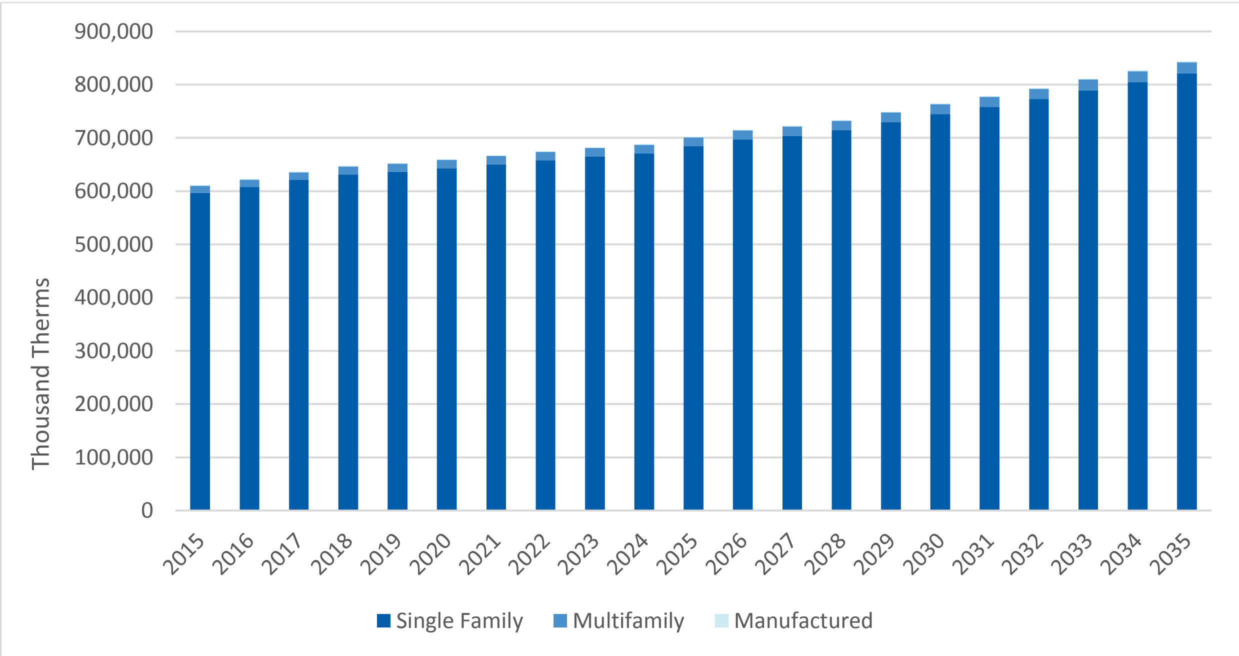

Figure B-1.5 Commercial Gas Baseline Forecast 2015-2035

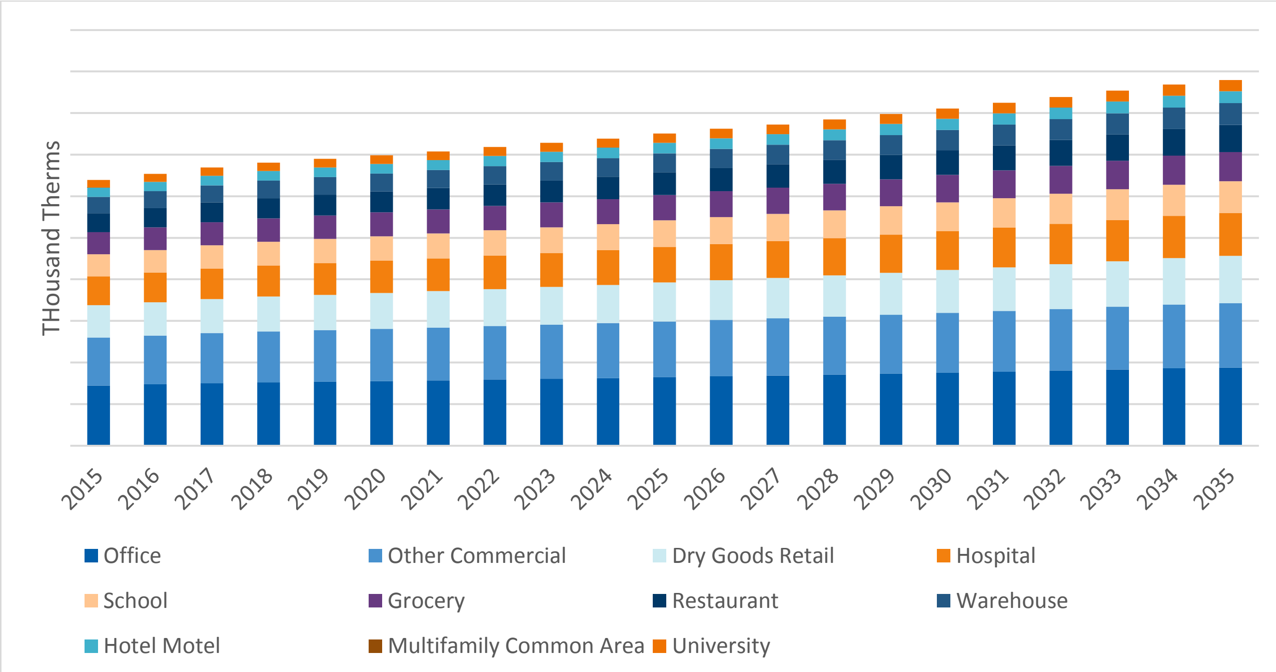

Figure B-1.6 Industrial Gas Baseline Forecast 2015-2035

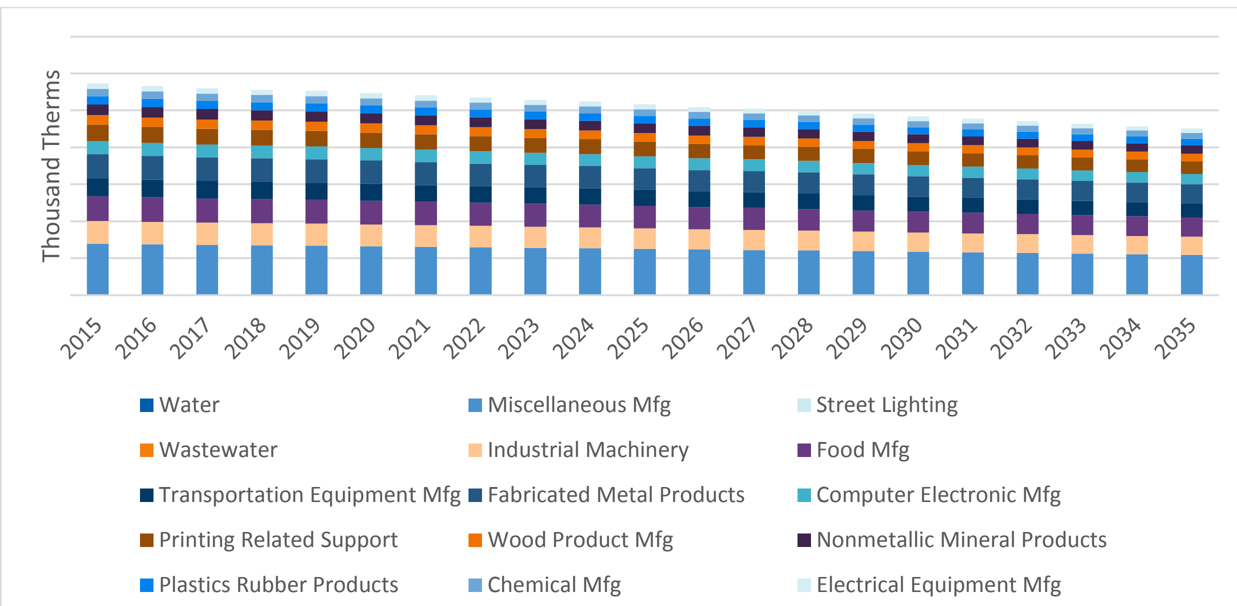

Table B-1.1 Electric Residential Saturations, Fuel Shares, and UECs

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average UEC Existing (Annual kWh)	Weighted Average UEC New (Annual kWh)
Manufactured	Air Purifier	1%	100%	489	489
Manufactured	Computer	180%	100%	195	195
Manufactured	Cooking Oven	70%	91%	105	105
Manufactured	Cooking Range	68%	90%	53	53
Manufactured	Cool Central	28%	100%	261	193
Manufactured	Cool Room	18%	100%	272	231
Manufactured	Copier	0%	100%	0	0
Manufactured	Dryer	92%	94%	783	619
Manufactured	DVD	148%	100%	22	22
Manufactured	Freezer	56%	100%	387	387
Manufactured	Heat Central	65%	75%	8,268	4,022
Manufactured	Heat Pump	23%	100%	6,510	3,258
Manufactured	Heat Room	2%	100%	9,011	4,598
Manufactured	Home Audio System	92%	100%	102	102
Manufactured	Lighting Exterior	129%	100%	49	40
Manufactured	Lighting Interior Specialty	488%	100%	32	32
Manufactured	Lighting Interior Standard	1888%	100%	20	16
Manufactured	Microwave	51%	100%	121	121
Manufactured	Monitor	72%	100%	58	58
Manufactured	Multifunction Device	98%	100%	183	183
Manufactured	Other	100%	100%	1,066	1,066
Manufactured	Plug Load Other	100%	100%	716	716
Manufactured	Printer	0%	100%	0	0
Manufactured	Refrigerator	125%	100%	516	516
Manufactured	Set Top Box	134%	100%	182	182
Manufactured	TV	136%	100%	216	216
Manufactured	TV Bigscreen	57%	100%	483	483
Manufactured	Ventilation And Circulation	65%	100%	737	737
Manufactured	Water Heat GT 55 Gal	8%	89%	4,022	1,856
Manufactured	Water Heat LE 55 Gal	92%	89%	3,766	3,716
Multifamily	Air Purifier	2%	100%	489	489
Multifamily	Computer	159%	100%	195	195
Multifamily	Cooking Oven	80%	91%	105	105
Multifamily	Cooking Range	79%	89%	53	53
Multifamily	Cool Central	11%	100%	257	225
Multifamily	Cool Room	10%	100%	100	96

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average UEC Existing (Annual kWh)	Weighted Average UEC New (Annual kWh)
Multifamily	Copier	0%	100%	0	0
Multifamily	Dryer	80%	100%	783	619
Multifamily	DVD	127%	100%	22	22
Multifamily	Freezer	14%	100%	387	387
Multifamily	Heat Central	24%	29%	5,237	3,152
Multifamily	Heat Pump	1%	100%	4,990	3,580
Multifamily	Heat Room	67%	100%	2,385	1,450
Multifamily	Home Audio System	78%	100%	102	102
Multifamily	Lighting Exterior	112%	100%	48	39
Multifamily	Lighting Interior Specialty	670%	100%	29	29
Multifamily	Lighting Interior Standard	1396%	100%	18	15
Multifamily	Microwave	69%	100%	131	131
Multifamily	Monitor	99%	100%	58	58
Multifamily	Multifunction Device	88%	100%	183	183
Multifamily	Other	100%	100%	1,066	1,066
Multifamily	Plug Load Other	100%	100%	319	319
Multifamily	Printer	0%	100%	0	0
Multifamily	Refrigerator	108%	100%	516	516
Multifamily	Set Top Box	104%	100%	182	182
Multifamily	TV	136%	100%	216	216
Multifamily	TV Bigscreen	57%	100%	483	483
Multifamily	Ventilation And Circulation	24%	100%	525	525
Multifamily	Water Heat GT 55 Gal	5%	84%	2,264	1,045
Multifamily	Water Heat LE 55 Gal	95%	84%	2,120	2,092
Single Family	Air Purifier	3%	100%	489	489
Single Family	Computer	166%	100%	195	195
Single Family	Cooking Oven	99%	83%	105	105
Single Family	Cooking Range	86%	67%	53	53
Single Family	Cool Central	32%	100%	653	440
Single Family	Cool Room	8%	100%	50	29
Single Family	Copier	0%	100%	0	0
Single Family	Dryer	99%	100%	783	619
Single Family	DVD	164%	100%	22	22
Single Family	Freezer	39%	100%	387	387
Single Family	Heat Central	72%	8%	10,839	5,060
Single Family	Heat Pump	9%	100%	7,981	4,129
Single Family	Heat Room	8%	100%	7,211	3,437

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average UEC Existing (Annual kWh)	Weighted Average UEC New (Annual kWh)
Single Family	Home Audio System	173%	100%	102	102
Single Family	Lighting Exterior	616%	100%	47	39
Single Family	Lighting Interior Specialty	1989%	100%	30	30
Single Family	Lighting Interior Standard	2620%	100%	21	17
Single Family	Microwave	84%	100%	131	131
Single Family	Monitor	88%	100%	58	58
Single Family	Multifunction Device	122%	100%	183	183
Single Family	Other	100%	100%	1,066	1,066
Single Family	Plug Load Other	100%	100%	760	760
Single Family	Pool Pump	3%	100%	2,465	746
Single Family	Printer	0%	100%	0	0
Single Family	Refrigerator	135%	100%	516	516
Single Family	Set Top Box	164%	100%	182	182
Single Family	TV	150%	100%	216	216
Single Family	TV Bigscreen	58%	100%	483	483
Single Family	Ventilation And Circulation	72%	100%	901	901
Single Family	Water Heat GT 55 Gal	13%	41%	3,715	1,714
Single Family	Water Heat LE 55 Gal	90%	41%	3,479	3,433

Table B-1.2 Residential Natural Gas Saturations, Fuel Shares, and UECs

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average UEC Existing (Annual Therms)	Weighted Average UEC New (Annual Therms)
Manufactured	Cooking Oven	79%	57%	7	7
Manufactured	Cooking Range	53%	52%	26	26
Manufactured	Dryer	75%	11%	30	24
Manufactured	Heat Central Boiler	0%	100%	336	169
Manufactured	Heat Central Furnace	87%	88%	422	210
Manufactured	Other	100%	100%	6	6
Manufactured	Water Heat GT 55 Gal	8%	55%	202	151
Manufactured	Water Heat	92%	55%	201	195

	LE 55 Gal				
Multifamily	Cooking Oven	84%	45%	7	7
Multifamily	Cooking Range	74%	54%	26	26
Multifamily	Dryer	91%	7%	30	24
Multifamily	Heat Central Boiler	2%	100%	609	380
Multifamily	Heat Central Furnace	60%	91%	350	218
Multifamily	Other	100%	100%	6	6
Multifamily	Water Heat GT 55 Gal	5%	79%	207	155
Multifamily	Water Heat LE 55 Gal	95%	79%	206	200
Single Family	Cooking Oven	99%	22%	7	7
Single Family	Cooking Range	84%	44%	26	26
Single Family	Dryer	99%	14%	30	24
Single Family	Heat Central Boiler	2%	100%	859	449
Single Family	Heat Central Furnace	89%	97%	690	342
Single Family	Other	100%	100%	6	6
Single Family	Pool Heat	3%	47%	258	258
Single Family	Water Heat GT 55 Gal	13%	84%	240	180
Single Family	Water Heat LE 55 Gal	90%	84%	239	232

Table B-1.3 Commercial Electric Saturations, Fuel Shares, and EUIs

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
Dry Goods Retail	Computers	100%	100%	0.08	0.08
Dry Goods Retail	Cooling DX	48%	100%	1.89	0.93
Dry Goods Retail	Fax	100%	100%	0.01	0.01
Dry Goods Retail	Flat Screen Monitors	100%	100%	0.02	0.02
Dry Goods Retail	Freezer	100%	100%	0.00	0.00
Dry Goods Retail	Heat Pump	10%	100%	2.90	1.43
Dry Goods Retail	Lighting Exterior	100%	100%	1.11	1.11
Dry Goods Retail	Lighting Interior Fluorescent	100%	100%	6.22	0.00
Dry Goods Retail	Lighting Interior HID	100%	100%	1.11	0.00
Dry Goods Retail	Lighting Interior Other	100%	100%	0.24	6.38

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
Dry Goods Retail	Lighting Interior Screw Base	100%	100%	1.61	0.00
Dry Goods Retail	Other	100%	100%	0.00	0.00
Dry Goods Retail	Other Plug Load	100%	100%	0.65	0.65
Dry Goods Retail	Photo Copiers	100%	100%	0.02	0.02
Dry Goods Retail	Printers	100%	100%	0.01	0.01
Dry Goods Retail	Refrigerator	100%	100%	0.02	0.02
Dry Goods Retail	Space Heat	78%	24%	2.02	0.45
Dry Goods Retail	Vending Machines	100%	100%	0.07	0.07
Dry Goods Retail	Ventilation and Circulation	88%	100%	2.71	2.21
Dry Goods Retail	Water Heat GT 55 Gal	100%	68%	0.29	0.13
Dry Goods Retail	Water Heat LE 55 Gal	100%	68%	0.27	0.28
Grocery	Computers	100%	100%	0.05	0.05
Grocery	Cooking	100%	56%	2.67	2.67
Grocery	Cooling DX	59%	100%	1.72	1.44
Grocery	Fax	100%	100%	0.02	0.02
Grocery	Flat Screen Monitors	100%	100%	0.01	0.01
Grocery	Freezer	100%	100%	0.00	0.00
Grocery	Heat Pump	13%	100%	4.57	1.65
Grocery	Lighting Exterior	100%	100%	1.05	1.05
Grocery	Lighting Interior Fluorescent	100%	100%	8.22	0.00
Grocery	Lighting Interior HID	100%	100%	1.32	0.00
Grocery	Lighting Interior Other	100%	100%	0.17	7.71
Grocery	Lighting Interior Screw Base	100%	100%	1.11	0.00
Grocery	Other	100%	100%	0.00	0.00
Grocery	Other Plug Load	100%	100%	0.99	0.99
Grocery	Photo Copiers	100%	100%	0.08	0.08
Grocery	Printers	100%	100%	0.01	0.01
Grocery	Refrigeration	100%	100%	20.19	20.19
Grocery	Refrigerator	100%	100%	0.06	0.06
Grocery	Space Heat	73%	11%	2.14	0.19
Grocery	Vending Machines	100%	100%	0.19	0.19
Grocery	Ventilation and Circulation	87%	100%	2.14	2.57
Grocery	Water Heat GT 55 Gal	100%	32%	0.30	0.14
Grocery	Water Heat LE 55 Gal	100%	32%	0.29	0.30
Hospital	Computers	100%	100%	0.33	0.33

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
Hospital	Cooking	100%	32%	0.54	0.54
Hospital	Cooling Chillers	23%	100%	1.90	0.42
Hospital	Cooling DX	49%	100%	1.89	0.49
Hospital	Fax	100%	100%	0.00	0.00
Hospital	Flat Screen Monitors	100%	100%	0.10	0.10
Hospital	Freezer	100%	100%	0.01	0.01
Hospital	Heat Pump	7%	100%	3.63	1.54
Hospital	Lighting Exterior	100%	100%	0.58	0.58
Hospital	Lighting Interior Fluorescent	100%	100%	4.80	0.00
Hospital	Lighting Interior HID	100%	100%	0.13	0.00
Hospital	Lighting Interior Other	100%	100%	0.25	4.44
Hospital	Lighting Interior Screw Base	100%	100%	1.67	0.00
Hospital	Other	100%	100%	0.00	0.00
Hospital	Other Plug Load	100%	100%	3.53	3.53
Hospital	Photo Copiers	100%	100%	0.02	0.02
Hospital	Printers	100%	100%	0.03	0.03
Hospital	Refrigeration	100%	100%	0.44	0.44
Hospital	Refrigerator	100%	100%	0.12	0.12
Hospital	Servers	100%	100%	0.06	0.06
Hospital	Space Heat	87%	48%	1.26	0.69
Hospital	Vending Machines	100%	100%	0.05	0.05
Hospital	Ventilation and Circulation	93%	100%	5.37	4.19
Hospital	Water Heat GT 55 Gal	100%	48%	1.41	0.65
Hospital	Water Heat LE 55 Gal	100%	48%	1.32	1.37
Hotel Motel	Computers	100%	100%	0.07	0.07
Hotel Motel	Cooking	100%	8%	0.65	0.65
Hotel Motel	Cooling Chillers	27%	100%	1.67	0.45
Hotel Motel	Cooling DX	16%	100%	1.67	0.53
Hotel Motel	Fax	100%	100%	0.00	0.00
Hotel Motel	Flat Screen Monitors	100%	100%	0.02	0.02
Hotel Motel	Freezer	100%	100%	0.02	0.02
Hotel Motel	Heat Pump	27%	100%	3.80	1.94
Hotel Motel	Lighting Exterior	100%	100%	0.66	0.66
Hotel Motel	Lighting Interior Fluorescent	100%	100%	2.06	0.00
Hotel Motel	Lighting Interior HID	100%	100%	0.08	0.00
Hotel Motel	Lighting Interior	100%	100%	0.06	4.20

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
	Other				
Hotel Motel	Lighting Interior Screw Base	100%	100%	5.46	0.00
Hotel Motel	Other	100%	100%	0.00	0.00
Hotel Motel	Other Plug Load	100%	100%	0.78	0.78
Hotel Motel	Photo Copiers	100%	100%	0.01	0.01
Hotel Motel	Printers	100%	100%	0.01	0.01
Hotel Motel	Refrigeration	100%	100%	0.19	0.19
Hotel Motel	Refrigerator	100%	100%	0.22	0.22
Hotel Motel	Space Heat	57%	53%	4.01	2.55
Hotel Motel	Vending Machines	100%	100%	0.09	0.09
Hotel Motel	Ventilation and Circulation	90%	100%	3.24	2.02
Hotel Motel	Water Heat GT 55 Gal	100%	39%	1.74	0.81
Hotel Motel	Water Heat LE 55 Gal	100%	39%	1.63	1.71
Multifamily Common Area	Lighting Interior Fluorescent	100%	100%	6.47	0.00
Multifamily Common Area	Lighting Interior HID	100%	100%	0.35	0.00
Multifamily Common Area	Lighting Interior Other	100%	100%	0.07	6.46
Multifamily Common Area	Lighting Interior Screw Base	100%	100%	0.77	0.00
Office	Computers	100%	100%	0.60	0.60
Office	Cooling Chillers	23%	100%	2.14	0.67
Office	Cooling DX	39%	100%	1.53	0.54
Office	Fax	100%	100%	0.01	0.01
Office	Flat Screen Monitors	100%	100%	0.19	0.19
Office	Freezer	100%	100%	0.00	0.00
Office	Heat Pump	27%	100%	3.00	1.30
Office	Lighting Exterior	100%	100%	0.51	0.51
Office	Lighting Interior Fluorescent	100%	100%	5.11	0.00
Office	Lighting Interior HID	100%	100%	0.21	0.00
Office	Lighting Interior Other	100%	100%	0.04	3.91
Office	Lighting Interior Screw Base	100%	100%	0.67	0.00
Office	Other	100%	100%	0.00	0.00
Office	Other Plug Load	100%	100%	0.38	0.38
Office	Photo Copiers	100%	100%	0.03	0.03
Office	Printers	100%	100%	0.04	0.04

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
Office	Refrigerator	100%	100%	0.05	0.05
Office	Servers	100%	100%	0.10	0.10
Office	Space Heat	56%	61%	3.21	0.66
Office	Vending Machines	100%	100%	0.09	0.09
Office	Ventilation and Circulation	85%	100%	1.53	1.29
Office	Water Heat GT 55 Gal	100%	82%	0.47	0.22
Office	Water Heat LE 55 Gal	100%	82%	0.44	0.46
Other Commercial	Computers	100%	100%	0.15	0.15
Other Commercial	Cooking	100%	53%	0.39	0.39
Other Commercial	Cooling Chillers	7%	100%	1.82	0.70
Other Commercial	Cooling DX	29%	100%	1.84	0.82
Other Commercial	Fax	100%	100%	0.02	0.02
Other Commercial	Flat Screen Monitors	100%	100%	0.05	0.05
Other Commercial	Freezer	100%	100%	0.00	0.00
Other Commercial	Heat Pump	9%	100%	3.01	1.37
Other Commercial	Lighting Exterior	100%	100%	1.23	1.23
Other Commercial	Lighting Interior Fluorescent	100%	100%	2.93	0.00
Other Commercial	Lighting Interior HID	100%	100%	1.07	0.00
Other Commercial	Lighting Interior Other	100%	100%	0.09	3.28
Other Commercial	Lighting Interior Screw Base	100%	100%	0.69	0.00
Other Commercial	Other	100%	100%	0.00	0.00
Other Commercial	Other Plug Load	100%	100%	0.58	0.58
Other Commercial	Photo Copiers	100%	100%	0.05	0.05
Other Commercial	Printers	100%	100%	0.01	0.01
Other Commercial	Refrigeration	100%	100%	0.12	0.12
Other Commercial	Refrigerator	100%	100%	0.05	0.05
Other Commercial	Servers	100%	100%	0.52	0.52
Other Commercial	Space Heat	73%	44%	2.62	0.55
Other Commercial	Vending Machines	100%	100%	0.08	0.08
Other Commercial	Ventilation and Circulation	83%	100%	2.12	1.75
Other Commercial	Water Heat GT 55 Gal	100%	60%	0.38	0.17
Other Commercial	Water Heat LE 55 Gal	100%	60%	0.36	0.37
Restaurant	Computers	100%	100%	0.13	0.13
Restaurant	Cooking	100%	18%	9.42	9.42
Restaurant	Cooling DX	51%	100%	4.12	1.54
Restaurant	Fax	100%	100%	0.02	0.02

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
Restaurant	Flat Screen Monitors	100%	100%	0.04	0.04
Restaurant	Freezer	100%	100%	0.00	0.00
Restaurant	Heat Pump	14%	100%	4.88	1.93
Restaurant	Lighting Exterior	100%	100%	2.36	2.36
Restaurant	Lighting Interior Fluorescent	100%	100%	4.24	0.00
Restaurant	Lighting Interior HID	100%	100%	0.33	0.00
Restaurant	Lighting Interior Other	100%	100%	0.33	6.12
Restaurant	Lighting Interior Screw Base	100%	100%	4.67	0.00
Restaurant	Other	100%	100%	0.00	0.00
Restaurant	Other Plug Load	100%	100%	1.28	1.28
Restaurant	Photo Copiers	100%	100%	0.08	0.08
Restaurant	Printers	100%	100%	0.01	0.01
Restaurant	Refrigeration	100%	100%	5.33	5.33
Restaurant	Refrigerator	100%	100%	0.05	0.05
Restaurant	Space Heat	76%	12%	1.35	0.31
Restaurant	Ventilation and Circulation	89%	100%	3.57	2.84
Restaurant	Water Heat GT 55 Gal	100%	38%	8.85	4.01
Restaurant	Water Heat LE 55 Gal	100%	38%	8.30	8.51
School	Computers	100%	100%	0.48	0.48
School	Cooking	100%	55%	0.22	0.22
School	Cooling Chillers	25%	100%	0.37	0.16
School	Cooling DX	21%	100%	0.34	0.16
School	Fax	100%	100%	0.01	0.01
School	Flat Screen Monitors	100%	100%	0.15	0.15
School	Freezer	100%	100%	0.00	0.00
School	Heat Pump	25%	100%	2.70	1.16
School	Lighting Exterior	100%	100%	0.76	0.76
School	Lighting Interior Fluorescent	100%	100%	3.34	0.00
School	Lighting Interior HID	100%	100%	0.40	0.00
School	Lighting Interior Other	100%	100%	0.01	2.90
School	Lighting Interior Screw Base	100%	100%	0.16	0.00
School	Other	100%	100%	0.00	0.00
School	Other Plug Load	100%	100%	0.02	0.02
School	Photo Copiers	100%	100%	0.05	0.05

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
School	Printers	100%	100%	0.03	0.03
School	Refrigeration	100%	100%	0.41	0.41
School	Refrigerator	100%	100%	0.05	0.05
School	Servers	100%	100%	0.03	0.03
School	Space Heat	74%	9%	5.67	1.84
School	Vending Machines	100%	100%	0.08	0.08
School	Ventilation and Circulation	99%	100%	1.32	0.89
School	Water Heat GT 55 Gal	100%	34%	1.51	0.67
School	Water Heat LE 55 Gal	100%	34%	1.42	1.42
University	Computers	100%	100%	0.48	0.48
University	Cooking	100%	55%	0.42	0.42
University	Cooling Chillers	4%	100%	0.37	0.16
University	Cooling DX	5%	100%	0.34	0.16
University	Fax	100%	100%	0.01	0.01
University	Flat Screen Monitors	100%	100%	0.15	0.15
University	Freezer	100%	100%	0.00	0.00
University	Heat Pump	1%	100%	2.70	1.16
University	Lighting Exterior	100%	100%	0.76	0.76
University	Lighting Interior Fluorescent	100%	100%	2.60	0.00
University	Lighting Interior HID	100%	100%	0.27	0.00
University	Lighting Interior Other	100%	100%	0.03	3.00
University	Lighting Interior Screw Base	100%	100%	0.88	0.00
University	Other	100%	100%	0.00	0.00
University	Other Plug Load	100%	100%	0.02	0.02
University	Photo Copiers	100%	100%	0.05	0.05
University	Printers	100%	100%	0.03	0.03
University	Refrigeration	100%	100%	0.41	0.41
University	Refrigerator	100%	100%	0.05	0.05
University	Servers	100%	100%	0.03	0.03
University	Space Heat	95%	9%	5.67	1.84
University	Vending Machines	100%	100%	0.08	0.08
University	Ventilation and Circulation	96%	100%	1.32	0.89
University	Water Heat GT 55 Gal	100%	34%	1.51	0.67
University	Water Heat LE 55 Gal	100%	34%	1.42	1.42
Warehouse	Computers	100%	100%	0.10	0.10
Warehouse	Cooling Chillers	4%	100%	0.19	0.19

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
Warehouse	Cooling DX	14%	100%	0.19	0.23
Warehouse	Fax	100%	100%	0.01	0.01
Warehouse	Flat Screen Monitors	100%	100%	0.03	0.03
Warehouse	Freezer	100%	100%	0.00	0.00
Warehouse	Heat Pump	6%	100%	0.73	0.53
Warehouse	Lighting Exterior	100%	100%	0.28	0.28
Warehouse	Lighting Interior Fluorescent	100%	100%	1.48	0.00
Warehouse	Lighting Interior HID	100%	100%	1.30	0.00
Warehouse	Lighting Interior Other	100%	100%	0.01	1.90
Warehouse	Lighting Interior Screw Base	100%	100%	0.55	0.00
Warehouse	Other	100%	100%	0.00	0.00
Warehouse	Other Plug Load	100%	100%	0.26	0.26
Warehouse	Photo Copiers	100%	100%	0.03	0.03
Warehouse	Printers	100%	100%	0.01	0.01
Warehouse	Refrigerator	100%	100%	0.02	0.02
Warehouse	Space Heat	48%	26%	1.13	0.37
Warehouse	Vending Machines	100%	100%	0.03	0.03
Warehouse	Ventilation and Circulation	52%	100%	0.58	0.56
Warehouse	Water Heat GT 55 Gal	100%	82%	0.20	0.09

Table B-1.4 Commercial Gas Saturations, Fuel Shares, and EUIs

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
Dry Goods Retail	Other	100%	100%	0.000	0.000
Dry Goods Retail	Space Heat Boiler	9%	100%	0.068	0.038
Dry Goods Retail	Space Heat Furnace	83%	81%	0.102	0.057
Dry Goods Retail	Water Heat GT 55 Gal	8%	40%	0.033	0.024
Dry Goods Retail	Water Heat LE 55 Gal	92%	40%	0.029	0.029
Grocery	Cooking	100%	54%	0.194	0.194
Grocery	Other	100%	100%	0.000	0.000
Grocery	Space Heat Boiler	1%	100%	0.227	0.048

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
Grocery	Space Heat Furnace	96%	88%	0.338	0.072
Grocery	Water Heat GT 55 Gal	8%	80%	0.148	0.110
Grocery	Water Heat LE 55 Gal	92%	80%	0.130	0.132
Hospital	Cooking	100%	67%	0.037	0.037
Hospital	Other	100%	100%	0.000	0.000
Hospital	Space Heat Boiler	35%	85%	0.316	0.304
Hospital	Space Heat Furnace	56%	78%	0.469	0.461
Hospital	Water Heat GT 55 Gal	8%	64%	0.490	0.365
Hospital	Water Heat LE 55 Gal	92%	64%	0.430	0.437
Hotel Motel	Cooking	100%	98%	0.081	0.081
Hotel Motel	Other	100%	100%	0.000	0.000
Hotel Motel	Pool Heat	100%	44%	0.112	0.112
Hotel Motel	Space Heat Boiler	57%	69%	0.164	0.116
Hotel Motel	Space Heat Furnace	31%	44%	0.243	0.176
Hotel Motel	Water Heat GT 55 Gal	8%	77%	0.370	0.276
Hotel Motel	Water Heat LE 55 Gal	92%	77%	0.325	0.330
Office	Other	100%	100%	0.000	0.000
Office	Space Heat Boiler	28%	66%	0.212	0.103
Office	Space Heat Furnace	57%	41%	0.315	0.156
Office	Water Heat GT 55 Gal	8%	34%	0.042	0.031
Office	Water Heat LE 55 Gal	92%	34%	0.037	0.037
Other Commercial	Cooking	100%	49%	0.040	0.040
Other Commercial	Other	100%	100%	0.000	0.000
Other Commercial	Pool Heat	100%	13%	0.164	0.164
Other Commercial	Space Heat Boiler	25%	100%	0.140	0.070
Other Commercial	Space Heat Furnace	68%	73%	0.208	0.106
Other Commercial	Water Heat GT 55 Gal	8%	58%	0.037	0.028

Segment	End Use	Saturation	Electric Fuel Share	Weighted Average EUI (kWh/Sq Ft) Existing	Weighted Average EUI (kWh/Sq Ft) New
Other Commercial	Water Heat LE 55 Gal	92%	58%	0.033	0.033
Restaurant	Cooking	100%	82%	1.614	1.614
Restaurant	Other	100%	100%	0.000	0.000
Restaurant	Space Heat Boiler	0%	100%	0.042	0.031
Restaurant	Space Heat Furnace	92%	96%	0.062	0.046
Restaurant	Water Heat GT 55 Gal	8%	67%	0.513	0.382
Restaurant	Water Heat LE 55 Gal	92%	67%	0.450	0.457
School	Cooking	100%	46%	0.022	0.022
School	Other	100%	100%	0.000	0.000
School	Pool Heat	100%	13%	0.158	0.158
School	Space Heat Boiler	75%	98%	0.112	0.093
School	Space Heat Furnace	23%	83%	0.166	0.142
School	Water Heat GT 55 Gal	8%	79%	0.069	0.051
School	Water Heat LE 55 Gal	92%	79%	0.060	0.061
University	Cooking	100%	46%	0.049	0.049
University	Other	100%	100%	0.000	0.000
University	Pool Heat	100%	13%	0.151	0.151
University	Space Heat Boiler	75%	98%	0.224	0.187
University	Space Heat Furnace	23%	83%	0.332	0.283
University	Water Heat GT 55 Gal	8%	79%	0.117	0.087
University	Water Heat LE 55 Gal	92%	79%	0.102	0.104
Warehouse	Other	100%	100%	0.000	0.000
Warehouse	Space Heat Boiler	1%	100%	0.083	0.045
Warehouse	Space Heat Furnace	65%	84%	0.123	0.068
Warehouse	Water Heat GT 55 Gal	8%	20%	0.023	0.017
Warehouse	Water Heat LE 55 Gal	92%	20%	0.020	0.021

Table B-1.5 Industrial Electric End Use Percents by Segment

Segment	Fans	HVAC	Indirect Boiler	Lighting	Motors Other	Other	Process Aircomp	Process Cool	Process Electro Chemical	Process Heat	Process Other	Process Refrig	Pumps
Chemical Mfg	7%	7%	2%	4%	16%	3%	17%	9%	10%	5%	1%	5%	16%
Computer Electronic Mfg	4%	28%	1%	12%	8%	8%	1%	11%	1%	11%	8%	1%	7%
Electrical Equipment Mfg	5%	15%	0%	12%	10%	4%	11%	5%	0%	23%	3%	3%	10%
Fabricated Metal Products	7%	10%	0%	9%	19%	3%	8%	4%	2%	20%	3%	3%	12%
Food Mfg	3%	8%	2%	7%	17%	4%	3%	27%	0%	6%	1%	13%	7%
Industrial Machinery	6%	23%	0%	15%	18%	4%	7%	3%	0%	7%	2%	3%	11%
Misc. Mfg	5%	25%	2%	17%	20%	6%	5%	6%	0%	10%	1%	0%	3%
Nonmetallic Mineral Products	8%	6%	0%	5%	22%	3%	9%	3%	0%	22%	3%	4%	14%
Paper Mfg	15%	5%	4%	4%	30%	2%	4%	2%	1%	3%	1%	4%	24%
Petroleum Coal Products	12%	3%	1%	2%	34%	1%	14%	6%	0%	0%	0%	6%	21%
Plastics Rubber Products	7%	11%	1%	9%	20%	4%	8%	9%	0%	16%	0%	3%	13%
Primary Metal Mfg	4%	3%	0%	3%	18%	1%	4%	1%	32%	29%	1%	0%	3%
Printing Related Support	7%	19%	1%	12%	20%	6%	8%	6%	0%	3%	0%	4%	13%
Transport. Equipment Mfg	4%	19%	1%	15%	10%	5%	10%	6%	1%	13%	3%	3%	10%
Waste-water	0%	0%	0%	2%	0%	14%	66%	0%	0%	0%	0%	0%	18%
Water	10%	0%	0%	2%	10%	14%	0%	0%	0%	0%	0%	0%	64%
Wood Product Mfg	10%	5%	1%	7%	29%	4%	12%	1%	1%	7%	0%	5%	18%

Table B-1.6 Industrial Gas End Use Percents by Segment

End Use	HVAC	Indirect Boiler	Other	Process Heat	Process Other
Chemical Mfg	2%	60%	1%	28%	9%
Computer Electronic Mfg	40%	47%	3%	7%	2%
Electrical Equipment Mfg	21%	18%	2%	57%	3%
Fabricated Metal Products	15%	16%	2%	67%	0%
Food Mfg	5%	58%	0%	34%	4%
Industrial Machinery	40%	27%	1%	32%	0%
Misc. Mfg	55%	18%	0%	23%	5%
Nonmetallic Mineral Products	4%	5%	2%	87%	2%
Paper Mfg	3%	62%	3%	28%	4%
Petroleum Coal Products	1%	34%	0%	61%	5%
Plastics Rubber Products	20%	47%	3%	26%	5%
Primary Metal Mfg	6%	9%	11%	71%	3%
Printing Related Support	17%	12%	8%	62%	0%
Transport. Equipment Mfg	41%	20%	0%	36%	2%
Waste-water	0%	0%	100%	0%	0%
Water	0%	0%	100%	0%	0%
Wood Product Mfg	8%	30%	0%	58%	4%

Appendix B.2: Measure Descriptions

This section contains a brief description of each measure used in the energy-efficiency potential.

Residential Electric Retrofit Measure Descriptions

Heating and Cooling

Air-to-Air Heat Exchanger. This measure mechanically ventilates homes in cold climates. During the winter, it transfers heat from the air being exhausted to outside air entering the home. Between 50 and 80 percent of the heat normally lost in exhausted air is returned to the house. Air-to-air heat exchangers can be installed as part of a central heating and cooling system or in walls or windows. Wall- and window-mounted units resemble air conditioners and ventilate one room or area.

Ceiling Fan. ENERGY STAR®-qualified ceiling fans have improved motor and blade designs that allow the user to increase the thermostat set point by a few degrees, which decreases the AC cooling runtime yet still feels at least 5° cooler. The fans do not create cooler temperatures. This measure does not include light fixtures; all savings are associated with installing an ENERGY STAR® ceiling fan where no prior fan was present.

Ceiling Insulation. This measure represents an increase in R-value. Added ceiling insulation increases the building's thermal performance and brings the resistance value up to and past code, depending on the building vintage. Table B-2.1 summarizes the different resistance values compared in the measure.

Table B-2.1 Ceiling Insulation Efficiency Comparison

Measure Efficiency	Baseline Efficiency
R-49	R-0, R-8.0, R-11.9, R-38
R-38	R-0, R-9.6
R-60	R-49

Check Me! O&M Tune-up. Performing a system tune-up and regular maintenance ensures that the refrigerant charge and airflow through the evaporator coil (two factors that affect system efficiency) are properly tested and correctly adjusted. Maintenance includes changing filters and cleaning the coils to maintain the overall performance and efficiency of the unit.

Combined Duct Sealing and Insulation. Duct sealing and insulation save energy, improve air and thermal distribution (comfort and ventilation), and reduce cross contamination between different zones in buildings (i.e., smoking vs. non-smoking, bio-aerosols, localized indoor air pollutants). This measure assumes a baseline of existing duct conditions sealed and insulated to R-8 and R-11.

Construction, ICF. Building a concrete home with insulating concrete forms (ICFs) saves energy. Greater insulation, tighter construction, and the temperature-moderating mass of the walls conserve heating and cooling energy much better than conventional wood-frame walls.

Construction, SIP. A structural insulated panel (SIP) uses continuous foam insulation throughout the panel, which provides excellent energy efficiency and low levels of air infiltration. The baseline is standard wood framing.

Conversion Baseboard Heating to Ductless Heat Pump (DHP). DHPs move heat to or from the air to cool and heat a home without the need for costly ductwork. This method of heating has a HSPF value of 7.7, consuming less energy than baseboard heating that has a HSPF value of 1.

Conversion Electric Furnace to Air Source Heat Pump (ASHP). ASHPs move heat to or from the air to cool and heat a home. This method of heating has a HSPF value of 7.7, consuming less energy than an electric furnace that has a HSPF value of 1.

Conversion Room AC to Ductless Heat Pump (DHP). DHPs use less energy than room AC while also producing less noise and requiring no costly ductwork. DHPs have an efficiency of 13 SEER, replacing a room AC unit with an efficiency rating of 9.8 EER.

Doors. Composite or steel doors with a foam core increase overall insulation, slowing heat loss. This measure includes adding a thermal door with a resistance value of R-5 or R-11 to houses without a thermal or storm door (R-2.5).

Doors, Weatherization. Mounting weather stripping to the bottom of an exterior door minimizes infiltration door sweep. This type of weatherization consists of an extruded aluminum strip holding a flexible vinyl strip that blocks the air space between the door frame and the door. The baseline for this measure is no weather stripping.

Duct Fittings, Leak-Proof. The majority of duct leakage in residential HVAC systems is due to improperly sealed connections between ductwork and fittings. Even when duct connections are initially well-sealed, leakage may increase over time.

Duct Location. Locating ducts in conditioned spaces reduces wasted heat loss. Many homes have ducts that run through unconditioned areas (such as attics, garages, crawlspaces, and basements) for convenience and practical reasons. Ducts in unconditioned areas lose energy because of the temperature difference between conditioned air in the ducts and the surrounding space.

Fan, Whole House. A whole house fan is a simple and inexpensive method of cooling a house when outdoor temperatures are lower than indoor temperatures. The fan draws cool outdoor air inside the home through open windows and exhausts hot indoor air through the attic to the outside.

Floor Insulation. The addition of floor insulation increases the overall resistance value of a home and slows heat transfer from the basement to the upper levels. Table B-2.2 summarizes the different resistance values compared in the measure.

Table B-2.2 Floor Insulation Efficiency Comparison

Measure Efficiency	Baseline Efficiency
R-30	R-0, R-5.2, R-6.7, R-8.5
R-38	R-30

Green Roof. The added mass and thermal resistance of green roofs reduces the heating and cooling loads of the building. These roofs reduce the ambient temperature of the roof surface and slow the transfer of heat into the building, which reduces cooling costs. They also add insulation to the roof structure, reducing heating requirements in the winter. Additionally, they reduce the ambient temperature around the roof, which decreases the building's urban heat island effect.

HVAC Unit, Central AC and Heat Pump Commissioning, Controls & Sizing. Correctly-sized HVAC systems operate for longer periods of time (instead of cycling on and off frequently), which results in optimum equipment operating efficiency and better control.

Infiltration Control (Caulk, Weather Strip, etc.) Blower Door Test. Sealing air leaks in windows, doors, the roof, crawlspaces, and outside walls prevents drafts and reduces overall heating and cooling losses.

Programmable Thermostat. This measure controls set point temperature automatically, ensuring the HVAC system is not running during low-occupancy hours.

Radiant Barrier, Ceiling. A radiant barrier generally consists of a thin piece of aluminum installed in a ceiling that reduces the solar heat gain from the sun during the summer and traps heat in during the winter. These barriers reduce heat transfer between the air space of the roof deck and the attic floor.

Smart Siting. This measure, which applies only to new construction, entails optimizing the building orientation to minimize the heating and cooling load on the HVAC system.

Slab Insulation. Substantial heat can be lost through an uninsulated slab, resulting in cold, uncomfortable floors. Even if foundation walls have been insulated vertically under the slab, significant heat escapes from the slab edge closest to the cold outside air. This measure compares a slab insulated with R-15 insulation to a slab insulated to code R-10. Applicable to new construction only.

Solar Attic Fan. This measure provides forced attic fan ventilation, which reduces residential heat gains from the ceiling. Because this fan is solar-powered, it runs conveniently when the sun is shining. The baseline uses passive ventilation without a fan.

Thermal Shell, Infiltration at 0.2 ACH w/ HRV. Heat recovery ventilation (HRV) provides fresh air and improved climate control, while also saving energy by reducing the heating (or cooling) requirements of a building. Combining this feature with better infiltration control (0.2 air changes per hour) minimizes the energy needed to maintain a healthy level of fresh air and reduces heat loss due to air leakage.

Thermostat, Multi-Zone. A multi-zone programmable thermostat automatically controls the set point temperatures for multiple areas (rooms or zones), ensuring the HVAC system is not running during low-occupancy hours. The baseline for this measure is a programmable thermostat with central control only.

Wall Insulation, 2x4 and 2x6. The presence of wall insulation slows the transfer of heat and reduces the heating and cooling loads in a house. Table B-2.3 compares the different insulation levels for 2x4 and 2x6 framing.

Table B-2.3 Wall Insulation Efficiency Comparison

Measure Name	Measure Efficiency	Baseline Efficiency
Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)
Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)
Wall Insulation 2x6	R-21 (Above WA Code - Multi Family Only)	R-13 + R-6 sheathing (WA Code - Multi Family Only)

Wi-Fi Thermostat. Thermostats connected to the internet can be controlled from any location with an internet connection and follow occupant schedules for heating and cooling, decreasing run time for heating and cooling.

Windows. This measure provides increased building performance by reducing the U-value in existing and new construction windows, as shown in Table B-2.4.

Table B-2.4 Window Efficiency Comparison

Measure Efficiency	Baseline Efficiency
U-value = 0.22	U-value = 0.30 (WA Code)
U-value = 0.25	U-value = 0.30 (WA Code)
U-value = 0.30 (WA Code)	Double Pane (Existing Window)
U-value = 0.30 (WA Code)	Single Pane (Existing Window)

Window Overhang. A window overhang shades windows, which reduces solar heat gains and decreases the overall cooling load on the home.

Lighting

Daylighting Controls (Photocell), Outdoor. Photocells adjust lighting levels according to the level of daylight the room is receiving. The baseline is no daylighting controls.

Occupancy Sensor. An occupancy sensor turns off the lights after a space is unoccupied for a designated amount of time. The lights turn on again when the sensor detects a person in the space.

Time Clock, Exterior Lighting. This technology allows users to program times for lights outside the residence to be turned on and off automatically. Programmed exterior lighting saves energy by ensuring that lights are not left on during the daytime.

Water Heat

Clothes Washer. This clothes washer uses less energy and water than regular washers. We compared three levels of efficiency—in units of the corresponding Modified Energy Factor (MEF) —for this measure, as shown in Table B-2.5. The baseline MEF represents the average MEF of non-ENERGY STAR®-qualified models.

Table B-2.5 Clothes Washer Efficiency Comparison

Measure Efficiency	Baseline Efficiency
CEE Tier 2 (MEF 2.2 - 2.39) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)
RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)
CEE Tier 3 (MEF 2.4 or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)
ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)
CEE Tier 3 (MEF 2.4 or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)
ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)

Dishwasher. This dishwasher uses advanced technology to clean dishes with less water and energy. The efficient model uses less than 307 kWh/year (including standby consumption) and less than 5 gallons of water per cycle. The baseline model consumes 340 kWh/year.

Drain Water Heat Recovery. Also called gravity film heat exchanges, this device recovers heat energy from domestic drain water, which is then used to pre-heat cold water entering the hot water tank. This minimizes the temperature difference between the heating set point and the temperature of the water entering the system.

Faucet Aerators, Bathroom and Kitchen. Faucet aerators, by mixing water and air, reduce amounts of water flowing through faucets. The faucet aerator creates a fine water spray, using a screen inserted in the faucet head.

Table B-2.6 displays the measure and baseline efficiencies.

Table B-2.6 Aerator Efficiency Comparison

Measure Efficiency	Baseline Efficiency
0.5 GPM - Bathroom	2.2 GPM - Bathroom
1.0 GPM - Bathroom	2.2 GPM - Bathroom
1.5 GPM - Bathroom	2.2 GPM - Bathroom
2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)
1.5 GPM - Kitchen	2.2 GPM - Kitchen
2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)

Hot Water Pipe Insulation. The addition of R-4 insulation around pipes decreases heat loss. The baseline is a hot water pipe without insulation.

Low-Flow Showerheads. Low-flow showerheads mix water and air to reduce the amount of water that flows through the showerhead. The showerhead creates a fine water spray through an inserted screen in the showerhead.

Table B-2.7 displays the measure and baseline efficiencies.

Table B-2.7 Showerhead Efficiency Comparison

Measure Efficiency	Baseline Efficiency
2.0 GPM	2.24 GPM (RBSA Baseline: Manufactured)
2.0 GPM	2.14 GPM (RBSA Baseline: Multifamily)
2.0 GPM	2.14 GPM (RBSA Baseline: Single Family)
1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)
1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)
1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)
1.75 GPM	2.24 GPM (RBSA Baseline: Manufactured)
1.75 GPM	2.14 GPM (RBSA Baseline: Multifamily)
1.75 GPM	2.14 GPM (RBSA Baseline: Single Family)

Water Heater Tank Blanket. The installation of R-5 insulation on older models of water heaters helps reduce standby losses.

Water Heater Thermostat Setback. This measure generates savings by reducing the thermostat set point temperature from 135° to 120°F. The set point temperature on hot water systems is often set higher than necessary.

Appliances

Refrigerator/Freezer, Removal of Secondary. This refers to environmentally friendly disposal of unneeded or inefficient appliances such as secondary refrigerators or stand-alone freezers.

Stand-Alone Freezer, Removal. The removal of stand-alone freezers is beneficial because of the inefficient use of energy by these appliances. Proper disposal is required due to their use of hazardous materials such as Freon and CFCs.

Plug Load

1-Watt Standby Power. Standby power is the electricity used by small electrical equipment or appliances when they are switched off or are not performing their main function. Minimizing this loss to one watt or less can reduce this standby energy consumption by more than 50 percent.

Battery Charger, ENERGY STAR®. On average, these battery chargers use 35 percent less energy than conventional battery chargers, which draw as much as five to 20 times more energy than is actually stored in the battery (even when not actively charging a product). Battery charging systems recharge a variety of cordless products, including power tools, small household appliances, and electric shavers. The baseline is a standard battery charger.

Advanced Power Strip. Power strips with an occupancy sensor will turn power to all devices plugged into the strip on and off, such as computers, desk lights, and audio equipment, based on occupancy within the work area.

Other (Pool)

Pool Pump Timers. A pool pump with a timer set to run during off-peak times (starting after 8:00 p.m. and cycling off before 10:00 a.m.) reduces energy costs. Cycling the pumps will further reduce monthly costs. The baseline is a continuously running pump.

Residential Electric Equipment Measure Descriptions

Heating and Cooling

Air or Ground Source Heat Pump (ASHP or GSHP). Electric heat pumps move heat to or from the air or the ground to cool and heat a home. The current RTF single family and manufactured home market baseline is less than the new 2015 federal standard. Therefore, for single manufactured homes the federal baseline is assumed. Table B-2.8 displays the different efficiency levels we compared for this measure. The baseline size is the same as the measure size.

Table B-2.8 Air or Ground Source Heat Pump (ASHP or GSHP) Efficiencies

Measure Name	Measure Efficiency	Baseline Efficiency
Heat Pump - ENERGY STAR	ENERGY STAR Heat Pump - SEER/EER 14.5/12 and HSPF 8.2 (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)
Heat Pump - CEE Tier 2	CEE Tier 2 Heat Pump - SEER/EER 15/12.5 and HSPF 8.5 (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)
Heat Pump - Enhanced	Enhanced Heat Pump - SEER/EER 14/12 and HSPF 9.0 (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)
Heat Pump - Advanced	Advanced Heat Pump - SEER/EER 16/12.5 and HSPF 10 (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)
Heat Pump - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Heat Pump - SEER/EER 18/12.5 and HSPF 9.6 (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)
Heat Pump - Ground Source	ENERGY STAR Ground Source Heat Pump - EER 17.1 and 3.6 COP (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)

Central Air Conditioner. This measure consists of several different air conditioner technology/efficiency levels, as summarized in Table B-2.9. The baseline size is the same as the measure size.

Table B-2.9 Central Air Conditioner Efficiencies

Measure Name	Measure Efficiency	Baseline Efficiency
Central Air Conditioner - ENERGY STAR	ENERGY STAR Central Air Conditioner SEER/EER 14.5/12 (Split System)	Federal Standard 2015 Central Air Conditioner SEER/EER 13/11.2 (Split System)
Central Air Conditioner - CEE Tier 3	CEE Tier 3 Central Air Conditioner SEER/EER 16/13 (Split System)	Federal Standard 2015 Central Air Conditioner SEER/EER 13/11.2 (Split System)
Central Air Conditioner - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Central Air Conditioner	Federal Standard 2015 Central Air Conditioner SEER/EER

Measure Name	Measure Efficiency	Baseline Efficiency
	SEER/EER 18/13 (Split System)	13/11.2 (Split System)

Motor, ECM and ECM-VFD. Electronically commutated motors (ECMs) and ECMs with variable frequency drives (VFD) consume less power than the standard motor used in ventilation and circulation systems.

Room Air Conditioner (Room AC). 10,000 BTU/HR. ENERGY STAR®-qualified room ACs use less energy than conventional models through improved energy performance and timers, which allow for better temperature control. ENERGY STAR®-qualified room air conditioners have an efficiency rating of 10.8 EER, compared to standard models, which have an efficiency rating of 9.8 EER.

Lighting

Compact Fluorescent Lights (CFL) - Specialty. Specialty (or EISA exempt) bulbs include 3-way, candelabra, some globes, and some reflectors. CFLs use up to 77 percent less energy and have a longer life than incandescent specialty light bulb.

Compact Fluorescent Lights (CFL) - Standard. Standard CFLs use 67 percent less energy than the Energy Independence and Security Act (EISA) incandescent bulbs.

Light emitting diodes (LEDs) - Specialty. Specialty LEDs are solid-state devices that convert electricity to light, use 89 percent less energy, and have a long life.

Light emitting diodes (LEDs) - Standard. Standard LEDs use 72 percent less energy than the Energy Independence and Security Act (EISA) incandescent bulbs.

Incandescent – 2020 EISA Backstop Provisions. EISA contains a backstop provision that requires have a minimum efficacy of 45 lumens per watt lighting technologies, beginning in 2020.

Water Heat

Water Heater, Storage, Heat Pump,* CO_2 Heat Pump *and Solar. A high-efficiency storage water heater reduces standby loss and is more efficient than a standard electric water heater Heat pump water heater measure moves heat from a warm reservoir (such as air) into the hot water system. CO_2 heat pump water heaters use carbon dioxide as a refrigerant, emitting less carbon and decreasing fuel costs compared to a standard heat pump water heater. Solar Water Heaters use thermal energy to heat water without the use of electricity, gas, or heating oil.

Table B-2.10 displays the measure and baseline efficiencies.

Table B-2.10 Electric Water Efficiency Comparison

End Use	Measure Efficiency	Baseline Efficiency
Water Heat GT 55 Gal	RTF Market Standard Heat Pump Water Heater - EF 1.99	RTF Market Standard Heat Pump Water Heater - EF 1.99
Water Heat GT 55 Gal	RTF Tier 1 Heat Pump Water Heater - EF 2.05	RTF Market Standard Heat Pump Water Heater - EF 1.99
Water Heat GT 55 Gal	RTF Tier 2 Heat Pump Water Heater - EF 2.08	RTF Market Standard Heat Pump Water Heater - EF 1.99
Water Heat GT 55 Gal	CO2 Heat Pump Water Heater	RTF Market Standard Heat Pump Water Heater - EF 1.99
Water Heat GT 55 Gal	Solar Hot Water (SHW)	RTF Market Standard Heat Pump Water Heater - EF 1.99
Water Heat LE 55 Gal	RTF Tier 1 Heat Pump Water Heater - EF 1.43	Federal Standard 2015 Storage Water Heater - EF 0.948
Water Heat LE 55 Gal	RTF Tier 2 Heat Pump Water Heater - EF 2.08	Federal Standard 2015 Storage Water Heater - EF 0.948
Water Heat LE 55 Gal	RTF Tier 2 Heat Pump Water Heater - EF 2.08	Federal Standard 2015 Storage Water Heater - EF 0.948
Water Heat LE 55 Gal	CO2 Heat Pump Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.948
Water Heat LE 55 Gal	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948
Water Heat LE 55 Gal	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948

Water Heat LE 55 Gal

Appliances

Cooking Oven, High Efficiency. A high-efficiency cooking oven uses fans to circulate heat evenly throughout the oven (convection heat), operating at lower temperatures and achieving cook times quicker than a standard oven. The baseline is a standard oven.

Dryer, High Efficiency. A high-efficiency dryer has features (such as moisture sensors) that minimize energy usage while retaining performance. The efficiency levels for this measure are shown in Table B-2.11.

Table B-2.11 High Efficiency Dryer Comparison

Measure Name	Measure Efficiency	Baseline Efficiency
Dryer - Below Standard	Below Standard Dryer - EF 2.95	Below Standard Dryer - EF 2.95
Dryer - Federal Standard 2015	Federal Standard 2015 Dryer - CEF 3.73	Federal Standard 2015 Dryer - CEF 3.73
Dryer - Advanced Efficiency	Advanced - Efficiency Dryer - EF 4.10	Federal Standard 2015 Dryer - CEF 3.73
Dryer - Heat Pump Dryer	Premium Efficiency - Heat Pump Dryer (0.23 kWh/kg Clothing)	Federal Standard 2015 Dryer - CEF 3.73

Freezer, ENERGY STAR. ENERGY STAR® -qualified freezers use 10 percent less energy than standard models due to improvements in insulation and compressors.

Microwave, High Efficiency. High-efficiency microwaves use more efficient power supplies, fans, magnetron, and reflective surfaces that provide energy savings compared to conventional microwaves.

Refrigerator, ***ENERGY STAR.*** ENERGY STAR®-qualified refrigerators use 20 percent less energy than standard models, due to improvements in insulation and compressors.

Plug Load

Air Purifier, Energy Star. ENERGY STAR certified room air purifiers are 40% more energy-efficient than standard models[1].

Computer, ENERGY STAR. ENERGY STAR® computers consume less than 2 watts in sleep and off modes, and are more efficient than conventional units in idle mode, resulting in 30 percent to 65 percent energy savings.

DVD, ENERGY STAR. ENERGY STAR®-qualified DVD products meeting the new requirements use up to 60 percent less energy than standard models.[2] ENERGY STAR® DVD players use as little as one-fourth of the energy of standard models in the off mode. The baseline for this measure is a standard DVD player.

Home Audio System, ENERGY STAR. According to ENERGY STAR® products, a 6 percent energy savings can be achieved over standard home audio systems.[3]

Monitor, ENERGY STAR. ENERGY STAR® monitors feature: (1) on mode, where the maximum allowed power varies based on the computer monitor's resolution; (2) sleep mode, where computer monitors must consume 2 watts or less; and, (3) off mode, where computer monitors must consume 1 watt or less. The baseline equipment does not include these features.[4]

Multifunction Device (All-in-One). ENERGY STAR models meeting the most recent ENERGY STAR requirements are 40% more energy efficient, and feature efficient designs helping the equipment run cooler and last longer.

Office Copier, ENERGY STAR®. These copy machines are 40 percent more efficient than standard office copy machines.

Office Printer, ENERGY STAR®. These printers are 40 percent more efficient than standard printers.

1 https://www.energystar.gov/products/certified-products/detail/air-purifiers-cleaners
2 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=DP
3 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=HA
4 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.ShowProductGroup&pgw_code=MO

Set Top Box, ENERGY STAR. Set top boxes that have earned the ENERGY STAR® rating are at least 30 percent more efficient than conventional models.[5] The baseline measure is a standard receiver.

***TV, ENERGY STAR*.** ENERGY STAR®-qualified TVs use roughly 40 percent less energy than standard units.[6] ENERGY STAR® models are required to consume no more than 1 watt while in sleep mode. The baseline is a standard television, which generally consumes more than 3 watts when turned off.

Other (Pool)

Pool Pumps, VSD. This measure enables a pool pump motor to operate at variable speeds as opposed to constantly running at full power. The baseline for this measure is a standard one speed motor.

5 http://www.energystar.gov/index.cfm?c=settop_boxes.settop_boxes
6 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=TV

Residential Gas Retrofit Measure Descriptions

Heating

Air-to-Air Heat Exchanger. An air-to-air heat exchanger mechanically ventilates homes in cold climates. During the winter, it transfers heat from the air being exhausted to the fresh, outside air entering the home. Between 50 and 80 percent of the heat normally lost in exhausted air is returned to the house. Air-to-air heat exchangers can be installed as part of a central heating and cooling system or in walls or windows. Wall- and window-mounted units resemble air conditioners and will ventilate one room or area.[7]

Ceiling Insulation. This measure represents an increase in R-value. Added ceiling insulation increases the building's thermal performance and brings the resistance value up to and past code, depending on the building vintage. Table B-2.12 summarizes the different resistance values compared in the measure.

Table B-2.12 Ceiling Insulation Comparison

Measure Efficiency	Baseline Efficiency
R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)
R-49 (WA Code - Single Family and Manufactured Homes Only)	R-8.0 (Existing Insulation - Manufactured Homes Only)
R-49 (WA Code - Single Family and Manufactured Homes Only)	R-11.9 (Existing Insulation - Single Family Only)
R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)
R-38 (WA Code - Multi Family Only)	R-0 (Zero Insulation - Multi Family Only)
R-38 (WA Code - Multi Family Only)	R-9.6 (Existing Insulation - Multi Family Only)
R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)

Combined Duct Sealing and Insulation. Duct sealing and insulation cost-effectively save energy, improve air and thermal distribution (comfort and ventilation), and reduce cross contamination between different zones in buildings (i.e., smoking vs. non-smoking, bio-aerosols, localized indoor air pollutants). This measure assumes a baseline of existing duct conditions sealed and insulated to R-8 and R-11.

Construction, ICF. Building a concrete home with insulating concrete forms (ICFs) saves energy. Greater insulation, tighter construction, and the temperature-moderating mass of the walls conserve heating and cooling energy much better than conventional wood-frame walls.

Construction, SIP. A structural insulated panel (SIP) uses continuous foam insulation throughout the panel, which provides excellent energy efficiency and low levels of air infiltration. The baseline is standard wood framing.

7 http://cipco.apogee.net/res/reevhex.asp

Doors. Composite or steel doors with a foam core increase overall insulation, slowing heat loss. This measure includes adding a thermal door with a resistance value of R-5 or R-11 to houses without a thermal or storm door (R-2.5).

Doors, Weatherization. Mounting weather stripping to the bottom of an exterior door minimizes infiltration door sweep. This type of weatherization consists of an extruded aluminum strip holding a flexible vinyl strip that blocks the air space between the door frame and the door. The baseline for this measure is no weather stripping.

Duct Fittings, Leak-Proof. The majority of duct leakage in residential HVAC systems is due to improperly sealed connections between ductwork and fittings. Even when duct connections are initially well-sealed, leakage may increase over time.

Duct Location. Locating ducts in conditioned spaces reduces wasted heat loss.[8] Many homes have ducts that run through unconditioned areas (such as attics, garages, crawlspaces, and basements) for convenience and practical reasons. Ducts in unconditioned areas lose energy because of the temperature difference between conditioned air in the ducts and the surrounding space.

Floor Insulation. The addition of floor insulation increases the overall resistance value of a home and slows heat transfer from the basement to the upper levels. Table B-2.13 summarizes the different resistance values compared in the measure.

Table B-2.13 Floor Insulation Comparison

Measure Efficiency	Baseline Efficiency
R-30 (WA Code)	R-0 (Zero Insulation)
R-30 (WA Code)	R-6.7 (Existing Insulation: Manufactured Homes)
R-30 (WA Code)	R-5.2 (Existing Insulation: Multifamily)
R-30 (WA Code)	R-8.5 (Existing Insulation: Single Family)
R-38 (Above WA Code)	R-30 (WA Code)

Infiltration Control (Caulk, Weather Strip, etc.) ***Blower Door Test.*** Sealing air leaks in windows, doors, the roof, crawlspaces, and outside walls prevents drafts and reduces overall heating and cooling losses.

Integrated Space and Water Heating. These systems provide space conditioning and hot water heating in one appliance/energy source. Domestic hot water is heated directly and space is heated by a hot water heat exchanger coil piped to the forced air heating system. This combination space/water heating system provides high efficiency heating for the cost of one high efficiency appliance.

Programmable Thermostat. This measure controls set point temperature automatically, ensuring the HVAC system is not running during low-occupancy hours.

8 http://www.toolbase.org/pdf/techinv/ductsinconditionedspace_techspec.pdf

Radiant Barrier, Ceiling. A radiant barrier generally consists of a thin piece of aluminum installed in a ceiling that reduces the solar heat gain from the sun during the summer and traps heat in during the winter. These barriers reduce heat transfer between the air space of the roof deck and the attic floor.

Slab Insulation. Substantial heat can be lost through an uninsulated slab, resulting in cold, uncomfortable floors. Even if foundation walls have been insulated vertically under the slab, significant heat escapes from the slab edge closest to the cold outside air. This measure compares a slab insulated with R-15 insulation to a slab insulated to code R-10. Applicable to new construction only.

Smart Siting. This measure, which applies only to new construction, entails optimizing the building orientation to minimize the heating and cooling load on the HVAC system.

Thermal Shell, Infiltration at 0.2 ACH w/ HRV. Heat recovery ventilation (HRV) provides fresh air and improved climate control, while also saving energy by reducing the heating (or cooling) requirements of a building. Combining this feature with better infiltration control (0.2 air changes per hour) minimizes the energy needed to maintain a healthy level of fresh air and reduces heat loss due to air leakage.

Thermostat, Multi-Zone. A multi-zone programmable thermostat automatically controls the set point temperatures for multiple areas (rooms or zones), ensuring the HVAC system is not running during low-occupancy hours. The baseline for this measure is a programmable thermostat with central control only.

Wall Insulation, 2x4 and 2x6. The presence of wall insulation slows the transfer of heat and reduces the heating and cooling loads in a house. Table B-2.14 compares the different insulation levels for 2x4 and 2x6 framing.

Table B-2.14 Wall Insulation R-Value Comparison

Measure Name	Measure Insulation	Baseline Insulation
Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)
Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)
Wall Insulation 2x6	R-21 (Above WA Code - Multi Family Only)	R-13 + R-6 sheathing (WA Code - Multi Family Only)

Wi-Fi Thermostat. Thermostats connected to the internet can be controlled from any location with an internet connection and follow occupant schedules for heating and cooling, decreasing run time for heating and cooling.

Windows. This measure provides increased building performance by reducing the U-value in existing and new construction windows, as shown in Table B-2.15.

Table B-2.15 Window U-Value Comparison

Measure U-value	Baseline U-value
U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)
U-value = 0.25 (Above WA Code)	U-value = 0.30 (WA Code)
U-value = 0.30 (WA Code)	Double Pane (Existing Window)
U-value = 0.30 (WA Code)	Single Pane (Existing Window)

Water Heat

Clothes Washer, ENERGY STAR®. This clothes washer uses less energy and water than regular washers.[9] Three levels of efficiency—in units of the corresponding Modified Energy Factor (MEF) —are shown in **Error! Reference source not found.**. The baseline MEF represents the average MEF of non-ENERGY STAR®-qualified models.

Dishwasher, ENERGY STAR®. This dishwasher uses advanced technology to clean dishes with less water and energy. The efficient model uses less than 307 kWh/year (including standby consumption) and less than 5 gallons of water per cycle. The baseline model consumes 340 kWh/year.

Drain Water Heat Recovery. Also called gravity film heat exchanges, this device recovers heat energy from domestic drain water, which is then used to pre-heat cold water entering the hot water tank. This minimizes the temperature difference between the heating set point and the temperature of the water entering the system.

Faucet Aerators, Bathroom and Kitchen. This measure mixes water and air, reducing the amount of water that flows through the faucet. It creates a fine water spray through an inserted screen in the faucet head.

Table B-2.16 displays the measure and baseline efficiencies.

Table B-2.16 Aerator Efficiency Comparison

Measure Efficiency	Baseline Efficiency
0.5 GPM - Bathroom	2.2 GPM - Bathroom
1.0 GPM - Bathroom	2.2 GPM - Bathroom
1.5 GPM - Bathroom	2.2 GPM - Bathroom
2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)
1.5 GPM - Kitchen	2.2 GPM - Kitchen
2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)

9 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CW

Hot Water Pipe Insulation. The addition of R-4 insulation around pipes decreases heat loss. The baseline is a hot water pipe without insulation.

Low-Flow Showerheads. Low-flow showerheads mix water and air to reduce the amount of water that flows through the showerhead. The showerhead creates a fine water spray through an inserted screen in the showerhead.

Table B-2.17 displays the measure and baseline efficiencies.

Table B-2.17 Showerhead Efficiency Comparison

Measure Efficiency	Baseline Efficiency
2.0 GPM	2.24 GPM (RBSA Baseline: Manufactured)
2.0 GPM	2.14 GPM (RBSA Baseline: Multifamily)
2.0 GPM	2.14 GPM (RBSA Baseline: Single Family)
1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)
1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)
1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)
1.75 GPM	2.24 GPM (RBSA Baseline: Manufactured)
1.75 GPM	2.14 GPM (RBSA Baseline: Multifamily)
1.75 GPM	2.14 GPM (RBSA Baseline: Single Family)

Water Heater Tank Blanket. The installation of R-5 insulation on older models of water heaters helps reduce standby losses.

Water Heater Thermostat Setback. This measure generates savings by reducing the thermostat set point temperature from 135° to 120°F. The set point temperature on hot water systems is often set higher than necessary.

Residential Gas Equipment Measure Descriptions

Heating

Gas Boiler. Boilers are classified as condensing or non-condensing. Condensing boilers condense the flue gas and water vapor, extracting useful heat and improving the boiler efficiency. This measure compares several boilers with different thermal efficiencies and is applicable to both new and existing construction. The overall efficiency of the boiler is defined as the gross energy output divided by the energy input, and is affected by combustion efficiency, standby losses, cycling losses, and heat transfer. Table B-2.18 displays the measure and baseline thermal efficiencies.

Table B-2.18 Gas Boiler Efficiency Comparison

Measure Name	Measure Efficiency	Baseline Efficiency
Boiler - Below Standard	Below Standard Boiler - 78% AFUE	Below Standard Boiler - 78% AFUE
Boiler - Federal Standard 2012	Federal Standard 2012 Boiler - 82% AFUE	Federal Standard 2012 Boiler - 82% AFUE
Boiler - High Efficiency	High Efficiency Boiler - 90% AFUE	Federal Standard 2012 Boiler - 82% AFUE
Boiler - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Boiler - 95% AFUE	Federal Standard 2012 Boiler - 82% AFUE
Boiler - Advanced Efficiency	Advanced Efficiency Boiler - 98% AFUE	Federal Standard 2012 Boiler - 82% AFUE

Gas Furnace. Improvements in furnace technology, such as new ignition and heat exchange design, have led to increased furnace efficiency. The AFUE levels considered in this measure are shown in Table B-2.19.

Table B-2.19 Gas Furnace Efficiency Comparison

Measure Name	Measure Efficiency	Baseline Efficiency
Furnace - Below Standard	Below Standard Furnace - 76% AFUE	Below Standard Furnace - 76% AFUE
Furnace - Federal Standard 2007	Federal Standard 2007 Furnace - 78% AFUE	Federal Standard 2007 Furnace - 78% AFUE
Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2007 Furnace - 78% AFUE
Furnace - Advanced Efficiency	Advanced Efficiency Furnace - 95% AFUE	Federal Standard 2007 Furnace - 78% AFUE
Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2007 Furnace - 78% AFUE

Water Heat

Water Heater, Storage, Tankless, and Solar. A high-efficiency storage water heater reduces standby loss and is more efficient than a standard electric water heater. Tankless water heaters provides hot water at a preset temperature as needed without storage, thereby reducing or eliminating standby losses. Solar Water Heaters use thermal energy to heat water without the use of electricity, gas, or heating oil.

Table B-2.20 displays the measure and baseline efficiencies.

Table B-2.20 Natural Gas Water Heater Efficiency Comparison

End Use	Measure Efficiency	Baseline Efficiency
Water Heat GT 55 Gal	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743
Water Heat GT 55 Gal	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743
Water Heat LE 55 Gal	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615
Water Heat LE 55 Gal	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615
Water Heat LE 55 Gal	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615
Water Heat LE 55 Gal	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615

Appliances

High Efficiency Dryer. High efficiency dryers have features, such as moisture sensors, that minimize energy usage while retaining performance. Baseline is the Federal Standard 2015 Dryer with an EF of 3.30, compared to 3.36.

Other

Cooking Oven, High Efficiency. High-efficiency convection ovens operate at lower temperatures and achieve quicker cook times than standard ovens, due to fans circulating heat evenly throughout the oven. The baseline is a 2012 federal standard oven.

Energy Efficient Pool Heater. Gas pool heaters use natural gas or propane. The water circulated by the pump passes through a filter and then travels to the heater. Gas burns in the heater combustion chamber, generating heat that warms the water returning to the pool. This measure assumes an efficiency level of 88 percent, compared to a standard 83 percent efficient pool heater.

Commercial Electric Retrofit Measure Descriptions

HVAC (and Envelope)

Automated Exhaust Variable Frequency Drive (VFD) Control, Parking Garage CO Sensor. This measure allows the ventilation system to run only when CO levels rise above a specified level. The ventilation system would run constantly without this measure.

Automated Ventilation Variable Frequency Drive (VFD) Control, Occupancy/CO_2 sensors. This measure is also known as demand-control ventilation (DCV), where the ventilation system automatically adjusts air flow when CO_2 is above a specified level. CO_2 controls maintain a minimum ventilation rate at all times to control non-occupant contaminants, such as off-gassing from furniture, equipment, and building components. The baseline of this measure is a ventilation system that runs constantly.

Chilled Water/Condenser Water Settings, Optimization. Making adjustments to the chilled and condenser water system settings to better match the building load will reduce unnecessary use of the compressor and pumps.

Chilled Water Piping Loop with Variable Speed Drive (VSD) Control. A VSD controller, with two-way valves at the cooling coils, controls the chilled water pump speed to vary based on the cooling load, thus reducing pumping energy requirements. The baseline is a constant speed pump with three-way valves.

Chiller Water-Side Economizer. This measure consists of a heat exchanger attached to a condenser water piping loop that operates when outdoor conditions can produce colder condenser water than the mixed air temperature. A water side economizer is used when an outdoor-air economizer is not practical. The baseline measure is no economizer.

Convert Constant Volume Air System to Variable Air Volume (VAV). This measure allows the airflow volume of a HVAC system to vary the heating or cooling load rather than over-conditioning and short-cycling. The baseline is a constant volume system.

Cooling Tower, Decrease Approach Temperature. An oversized cooling tower allows a reduced approach temperature, which saves energy. The approach temperature is the difference between the water leaving the tower and the wet-bulb temperature. This measure assumes a 6 degree delta compared to the baseline of a 10 degree delta.

Cooling Tower, Variable Speed Drive (VSD) Fan Control. VSDs modulate the air flow so that heat rejection exactly matches load at the desired set point, which saves energy. The baseline measure is a two-speed fan motor.

Direct Digital Control (DDC) System, Installation. DDC systems allow for both HVAC and lighting to be controlled and monitored. For lighting, the DDC system allows for direct control of lights from a remote location. Entire HVAC systems, including pumps, motors, fans, and set points, can be digitally programmed for tighter control of the system.

Direct Digital Control (DDS) System, Wireless Performance Monitoring. This second-generation building automation systems allows for wireless optimization and operation of building systems (such as HVAC)
Direct Expansion (DX) Package Air-Side Economizer. An air-side economizer mixes return air with outside air to cool indoor spaces, which saves energy as less air needs to be cooled.

Direct Expansion (DX) Tune-Up/Diagnostics. Regular maintenance of DX air-conditioning systems includes checking controls, replacing filters, cleaning coils and blowers, and checking refrigerant levels.

Direct/Indirect Evaporative Cooling, Pre-Cooling. Direct evaporative coolers are low-energy systems that evaporate water into the air stream, thus reducing air temperature and increasing humidity. Indirect evaporative coolers use a secondary air stream that is cooled by water and travels through a heat exchanger with the primary air stream, cooling the air but not affecting the humidity. Direct/indirect systems cool the air stream via the indirect cooler, then cool it further through the direct cooler. Including an evaporative cooler before the DX system reduces the overall cooling load.

Duct Fittings, Leak-Proof. The majority of duct leakage in residential HVAC systems is due to improperly sealed connections between ductwork and fittings. Even when duct connections are initially well-sealed, leakage may increase over time.

Duct Repair and Sealing. This maintenance creates significant energy savings by ensuring conditioned air only goes to occupied spaces, thereby reducing an excessive runtime/load on the HVAC system.

Exhaust Air to Ventilation Air Heat Recovery. This measure captures heated air exhausted out of a building and transfers it to the incoming air, decreasing the overall heating load.

Exhaust Hood Makeup Air. This measure provides exhaust air at the hood instead of allowing the hood to exhaust conditioned air in the room. The baseline measure is for conditioned air to be expelled through exhaust hoods.

Green Roof. The added mass and thermal resistance of green roofs reduces the heating and cooling loads of the building. These roofs reduce the ambient temperature of the roof surface and slow the transfer of heat into the building, which reduces cooling costs. They also add insulation to the roof structure, reducing heating requirements in the winter.[10] Additionally, they reduce the ambient temperature around the roof, which decreases the building's urban heat island effect.

Hotel Key Occupancy Control System. This measure controls room HVAC and lighting during non-occupied periods. Occupancy is determined by the presence of a key card and/or additional sensors. The central system sets heating and cooling to a minimum and turns off lighting when the key card is removed. Once the key card is inserted, the hotel guest has full control of the room systems.

10 http://www.toolbase.org/Technology-Inventory/Roofs/green-roofs

Infiltration Reduction (Caulking, Weather Stripping, etc.). Sealing air leaks in windows, doors, the roof, crawlspaces, and outside walls decreases overall heating and cooling losses.

Insulation, Ceiling. These measures represent an increase in R-value from existing building conditions to current state code or from current state code to better than code. Baseline and measure values are presented in Table B-2.21.

Table B-2.21 Ceiling Insulation Efficiency Comparison

Measure Efficiency	Baseline Efficiency
R-38 c.i.	R-30 c.i. (WA State Code)
R-49 c.i.	R-38 c.i.
R-30 c.i. (WA State Code)	Average Existing Conditions
R-38 c.i.	R-30 c.i. (WA State Code)
R-49 c.i.	R-38 c.i.
R-30 c.i. (WA State Code)	Average Existing Conditions

Insulation, Duct. Packaged direct expansion and heat-pump equipment are generally coupled with a ducting system inside the building. Insulating these ducts reduces energy loss to the unconditioned plenum space. This measure assumes that R-7 insulation is installed where no insulation previously existed.

Insulation, Floor (Non-Slab). These measures represent an increase in R-value from existing building conditions to current state code or from current state code to better than code. The baseline and measure R-values are presented in Table B-2.22.

Table B-2.22 Floor (Non-Slab) Insulation Efficiency Comparison

Measure Efficiency	Baseline Efficiency
R-30 (WA State Code)	Average Existing Conditions
R-38	R-30 (WA State Code)
R-30 (WA State Code)	Average Existing Conditions
R-38	R-30 (WA State Code)

Insulation, Wall. These measures represent an increase in R-value from existing building conditions to the current state code value of R-13 + 7.5. The baseline value of R-3 represents the average existing insulation level.

Natural Ventilation System. This measure relies on pressure differences to move fresh air through buildings. Natural ventilation, unlike fan-forced ventilation, uses the natural forces of wind and buoyancy to deliver fresh air into buildings. The specific approach and design varies by building type and local climate. The amount of ventilation depends on internal space design and the size and placement of

openings in the building. Natural ventilation offsets the energy required to run forced air ventilation systems. [11]

Pipe Insulation. Adding 1.5-inches of insulation to water pipes yields an approximate R-value of R-6, which decreases temperature losses, thereby reducing demand on chilled water systems.

Programmable Thermostat, Web Enabled. This measure controls set point temperature automatically, ensuring the HVAC system is not running during low-occupancy hours.

Retro-Commissioning. Commissioning ensures that energy-using systems are operating in an optimal fashion in order to maximize energy efficiency. This commissioning process can be applied to existing buildings to restore them to optimal performance. Retro-commissioning is a systematic, documented process that identifies low-cost operational and maintenance improvements in existing buildings and brings them up to the design intentions.[12,13] The baseline measure is no commissioning.

Sensible Heat Recovery Devices. This measure preconditions incoming air by transferring energy between the exhaust air stream and the supply air stream. This raises the temperature of incoming air during the winter and decreases it in the summer. Energy savings results from the reduced need for mechanical heating or cooling.

Total Heat Recovery Devices. This measure, also called enthalpy recovery, transfers sensible and latent heat. Latent heat, which is released or absorbed due to a phase change (such as the condensation of water vapor), significantly raises the outdoor air humidity in the winter and reduces it in the summer.[14]

Water Source Heat Pump > 135 kBTU/hr. This measure results in fuel savings up to 11 percent compared to standard water source heat pumps >135 kBTU/kr.

Window Film. Solar control window films applied to existing windows reduces peak demand during hot months and conserves air conditioning energy. The use of these films also reduces exposure to ultraviolet radiation and glare.[15]

Windows, High Efficiency. This measure increases building performance by reducing the U-value, as shown in Table B-2.23.

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11 National Renewable Energy Laboratory; http://www.nrel.gov/docs/fy03osti/33698.pdf
12 http://www.green.ca.gov/CommissioningGuidelines/default.htm
13 http://cbs.lbl.gov/BPA/cct.html
14 http://www.mcquay.com/mcquaybiz/marketing_tools/mt_corporate/EngNews/0701.pdf
15 http://www.iwfa.com/iwfa/Consumer_Info/windowfilmbenefits.html

Table B-2.23 High Efficiency Window Efficiency Comparison

Measure Efficiency	Baseline Efficiency
U-0.32	U-0.40 (WA State Code)
U-0.40 (WA State Code)	Average Existing Conditions

Lighting

Bi-Level Control, Stairwell Lighting. This measure allows an occupancy sensor to reduce the light load in an unoccupied stairwell by 50 percent for a set amount of time. The baseline is continuous operation at full power.

Cold Cathode Lighting. This measure is a tubular light or bulb that passes an electrical current through a gas or vapor, much like neon lighting. A cold cathode light is up to five times brighter than neon, and has one of the longest lives of any lighting fixture at roughly 50,000 hours.[16] Cold cathode lighting uses 5 watts compared to 30 watts for an incandescent bulb.

Covered Parking Lighting. This measure reducing the energy use of covered parking garages by replacing inefficient metal halide lamps with LED and replacing high pressure sodium lamps with LED low bay lighting.

Daylighting Controls, Outdoors (Photocell). Exterior photocells adjust lighting levels according to sunlight levels reaching desired set points. This measure achieves savings over time-clock or manual controls through changes in seasonal and site conditions by improving night time durations.

Dimming, Continuous: Fluorescent Fixtures. A continuous dimming switch allows light level brightness to vary from 0 percent to 100 percent, increasing electricity savings. The baseline measure is fluorescent fixtures operating at full power.

Dimming, Stepped: Fluorescent Fixtures. This measure allows the user to vary the light level by a number of specified tiers to adjust for the amount of outside daylight. The baseline measure is fluorescent fixtures operating at full power.

Display Case Motion Sensors. Motion sensors decrease usage by shutting off power to light sources when the device is not in use. The baseline are display cases with no motion sensors.

Exit Sign, Light Emitting Diodes (LED). LED exit signs use only 2 watts of power and last over 50,000 hours, compared to CFL exit signs that use 9 watts of power and have a shorter life.

Exit Sign, Photoluminescent or Tritium. This measure uses no energy and provides lighting suitable for exit signage.

16 Conjecture Corporation of wisegeek.com; http://www.wisegeek.com/what-is-a-cold-cathode-light.htm

Exterior Building Lighting, Package. This measure decreases lighting power density by 30 percent. The baseline lighting technology includes all available technologies in a building that make up the total watts per square foot.

Light Emitting Diodes (LED) Refrigeration Case Lights. These highly efficient bulbs create 55 percent energy savings over standard 60 watt fluorescent refrigeration case light.

Occupancy Sensor Control. This measure turns off lights after a space is unoccupied for a designated amount of time. The lights turn on again when the sensor detects a person in the space. Occupancy measures can control single or multiple lighting zones. The controlled lighting wattage varies depending on application. The baseline assumes no lighting controls.

Solid State Light Emitting Diode (LED), White Lighting. LEDs are solid-state devices that convert electricity to light, with very high efficiency and long life. Recently, lighting manufacturers have indirectly produced 'cool' white LED lighting using ultraviolet LEDs to excite phosphors that emit a white-appearing light. This measure applies to exterior lighting for landscape, merchandise, signage, and structures. The baseline for this measure is 50 watts, 10 hrs/day, 365 days/yr.

Surface Parking Lighting. Replacing inefficient metal halide lamps that consume between 100-150 watts with LED lighting that consumes 60-111 watts reduces the energy use of surface parking lots. LED lights also last longer than metal halide lamps, reducing the labor of replace lamps.

Time Clock. This technology allows users to program lights and other loads to be turned on and off automatically in response to a time schedule, an occupancy sensor, or a building automation system.

Water Heat

Clothes Washer, Ozonating. This measure disinfects water with ozone-enriched air, which suppresses subsequent biological activity and controls biological growth within the appliance, thus reducing the need for hot water. The baseline measure is a standard commercial clothes washer.[17]

Clothes Washer Commercial, ENERGY STAR®. This measure has more capacity than conventional top-load models with an agitator. Some front-loaders can wash over 20 pounds of laundry at once, compared to 10–15 pounds for a standard top-loader.[18]

Demand-Controlled Circulating Systems. This measure circulates hot water only when required. The baseline measure is a continuously circulating hot water system, resulting in energy loss through pipes.

Dishwasher, Residential ENERGY STAR®. Residential sized ENERGY STAR® dishwashers are often appropriate for smaller commercial buildings, and are 10 percent more efficient than the federal minimum standard used as the baseline.[19]

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[17] http://www.patentstorm.us/patents/6607672-description.html

[18] http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers_comm

Dishwasher, Commercial: High Temperature ENERGY STAR®. This measure has a minimal idle rate, consumes a minimal amount of water per rack of loaded dishes, and is on average 25 percent more efficient than standard high temp commercial dishwashers.[20]

Dishwasher, Commercial: Low Temperature ENERGY STAR®. This measure uses chemicals combined with low temperatures to save energy compared to standard high temperature commercial dishwashers.

Drain Water Heat Recovery, Water Heater. This measure recovers heat energy from drain water and uses it to heat water entering the hot water tank, minimizing the temperature rise required to achieve the water heater set point.[21]

Hot Water (SHW) Pipe Insulation. One inch of extra insulation on hot water pipes yields an approximate R-value of R-4, decreasing temperature losses. This measure is only applicable for existing construction. The baseline measure is no insulation.

Low-Flow Faucet Aerators. This measure mixes water and air, reducing the amount of water that flows through the faucet. It creates a fine water spray through an inserted screen in the faucet head. Flow rate requirements for this measure are presented in Table B-2.24.

Table B-2.24 Low-Flow Faucet Aerators Efficiency Comparison

Measure Efficiency	Baseline Efficiency
1.5 GPM	2.2 GPM (Federal Code)
2.2 GPM (Federal Code)	3.0 GPM
1.0 GPM	2.2 GPM (Federal Code)
0.5 GPM	2.2 GPM (Federal Code)

Low-Flow Pre-Rinse Spray Valves. This measure mixes water and air, reducing the amount of water that flows through the spray head. The head creates a fine water spray through an inserted screen, achieving a flow reduction from 1.6 GPM (federal standard) to 0.6 GPM.

Low-Flow Showerheads. This measure mixes water and air, reducing the amount of water that flows through the showerhead. The showerhead creates a fine water spray through an inserted screen. Flow rate requirements for this measure are presented in Table B-2.25.

19 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=DW
20 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COH
21 www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=858&BucketID=6&CategoryID=9

Table B-2.25 Low-Flow Showerhead Efficiency Comparison

Measure Efficiency	Baseline Efficiency
2.0 GPM	2.5 GPM (Federal Code)
2.5 GPM (Federal Code)	3.0 GPM
1.75 GPM	2.5 GPM (Federal Code)
1.5 GPM	2.5 GPM (Federal Code)

Ultrasonic Faucet Control. Ultrasonic sensors automatically turn faucet water on and off when motion is detected at the sink. This eliminates water running continuously while the sink is in use.

Water Cooled Refrigeration with Heat Recovery. Heat recovery gathers and uses thermal energy for the water heater that would normally be rejected to the ambient environment.

Refrigeration

Add Doors to Refrigerated Open Display Cases. Doors on refrigerated cases create a barrier between the conditioned space and the non-conditioned space, decreasing energy use necessary to maintain temperature. The baseline are standard refrigerated open display cases.

Anti-Sweat (Humidistat) Controls. This measure enables the user to turn refrigeration display case anti-sweat heaters off when ambient relative humidity is low enough that sweating will not occur. Without controls, heaters generally run continuously.

Case Electronically Commutated Motor (ECM). A case fan is one component of a refrigeration system. ECMs are smaller variable speed motors that operate from a single-phase power source with an electronic controller in or on the motor. The baseline measure is a standard efficiency motor.

Case Replacement, Low and Medium Temperatures. Efficient refrigerated display cases achieve higher performance efficiency and reduce overall energy consumption by incorporating high performance evaporative fans, such as ECMs, energy-efficient double-pane glass doors, anti-sweat controls, high efficiency lighting and ballast, such as T8 or LED lamps, and improved insulation.

Commercial Refrigerator, Semivertical and Vertical No Doors Medium Temp. High efficiency semivertical and vertical refrigeration open cases (medium temperature) compared to standard equipment.

Compressor VSD Retrofit. This measure modulates motor speed in response to load changes. When low-load conditions exist, current to the compressor motor is decreased, slowing the compressor motor. Baseline is a constant-speed compressor.

Demand Control Defrost, Hot Gas. Evaporator frost reduces coil capacity by acting as a layer of insulation and reducing the airflow between fins. With hot gas defrost, refrigerant vapor from the compressor discharge or the high pressure receiver is used to warm the evaporator coil and melt the frost.[22]

Evaporative Condenser, High Efficiency. This water cooled measure can cycle a refrigerator with less energy than a standard air-cooled system.

Evaporator Fan Controller. This measure adds controls to evaporator fans that reduces fan speed by decreasing applied voltage. The base case is an evaporator fan with no controller.

Floating Condenser Head Pressure Controls. This measure adds controls to float head pressure temperature down during periods of low load. The base case is a standard multiplex system with a fixed condensing set point.

Glass Door, ENERGY STAR® Refrigerators/Freezers. Low-E, double-pane thermal glass doors reduce cooling loses in refrigerated reach-in cases.

High Efficiency Compressors. A component of refrigeration systems, this measure operates up to 15 percent more efficiently than standard-efficiency compressors.

Night Covers for Display Cases. This measure eliminates wasted refrigeration cooling by insulating display cases. In addition, it reduces the heating load of buildings by allowing less refrigerated air to escape and need reheated.

Refrigeration Commissioning or Re-Commissioning. Commissioning ensures that refrigeration systems are operating in an optimal fashion in order to maximize energy efficiency. Retro-commissioning checks previously commissioned equipment to ensure that it is continuing to run efficiently. The baseline measure is no commissioning.[23]

Solid-Door Refrigerators/Freezers, ENERGY STAR®. This measure is designed with high efficiency components such as an ECM evaporator, condenser fan motors, hot gas anti-sweat heaters, or high-efficiency compressors, saving energy compared to standard models.[24]

Standalone to Multiplex Compressor. This measure consists of multiple compressors drawing from a common suction header, serving any number of refrigerated display fixtures. The suction group is controlled to satisfy the lowest temperature required by any of the attached display fixtures, and therefore the fixtures served by a given suction group usually have similar temperature requirements. Baseline is a single dedicated compressor system for each refrigeration load.[25, 26]

22 Parker Refrigeration Specialists; http://www.parker.com/literature/Refrigerating%20Specialties%20Division/90-11a.pdf

23 http://cbs.lbl.gov/BPA/cct.html

24 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CRF

25 http://www.energysmartgrocer.org/pdfs/PGE/BridgeEquipment%20SpecificationTandCs.pdf

Strip Curtains on Walk-In Refrigerators. This measure reduces the infiltration of warm air into the refrigerated space by improving the barrier between the refrigerated and the ambient air.

Walk-In Electronically Commutated Motor (ECM). A walk-in fan is one component of refrigeration systems. ECMs typically have small horse power motors (less than 1 HP) that are factory programmed to run at certain speeds. ECMs operate from a single-phase power source with an electronic controller in or on the motor. The baseline measure is a standard efficiency motor.[27]

Variable Refrigerant Flow System. This energy efficient heating and cooling system using inverter driven compressor technology without ducting. Baseline technology is assumed to be a typical VAV rooftop HVAC system.

VFD Rooftop Unit Supply Fan (Grocery Only). This measure is installed on rooftop unit supply fans, serving grocery store sales floors. Units must have fixed ventilation damper and shut-off damper controls allowed, and must have continuous fan operation during occupied periods. Units with fans in "auto" mode do not qualify. A CO2 control is required to provide increased ventilation during times of high occupancy (maintain 1,150 ppm CO2 concentration).[28]

Visi Cooler. A Visi Cooler is a self-contained vertical storage cooler, with a glass door to visibly display retail products. Such coolers typically are found in grocery and restaurant businesses. Energy-efficient Visi Coolers include: high-efficiency cooling units; self-closing doors; and energy-efficient lighting.

Other

Battery Charger, ENERGY STAR®. On average, these battery chargers use 35 percent less energy than conventional battery chargers, which draw as much as five to 20 times more energy than is actually stored in the battery (even when not actively charging a product). Battery charging systems recharge a variety of cordless products, including power tools, small household appliances, and electric shavers. The baseline is a standard battery charger.[29]

Combination Oven. This measure uses both dry heat and steam, which are injected into the oven when the food being cooked needs it. High efficiency combination ovens with 60 percent efficiency use roughly half the energy of standard combination ovens.[30]

Cooking Hood Controls. Utilizing sensors and two-speed or variable speed fans, hood controls reduce exhaust (and makeup) airflow when appliances are not at capacity (or have been turned off). The baseline for this measure is no hood controls.

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26 http://www.bizlink.com/HPAC_articles/March2007/306.pdf
27 http://www.fishnick.com/publications/appliancereports/refrigeration/GE_ECM_revised.pdf
28 http://www.nwcouncil.org/energy/rtf/measures/Com/GroceryHVACvfd_v1_1.xlsm
29 http://www.energystar.gov/index.cfm?c=battery_chargers.pr_battery_chargers
30 http://www.energystar.gov/ia/partners/publications/pubdocs/restaurants_guide.pdf

Deep Fat Fryer, Consortium for Energy Efficiency (CEE). Commercial, 15 inch CEE rated electric fryers have a heavy load cooking efficiency of 80 percent or better, and use less than 1,000 watts when idle.[31] The baseline is standard electric deep fat fryer.

Griddle, ENERGY STAR®. This measure is approximately 10 percent more efficient than standard models, and must have a minimum cooking efficiency of 38 percent. They must use less than 0.026 therm/hour/ft^2 when idle. The baseline measure is a standard grill at 32 percent efficiency.[32]

High Efficiency Convection Oven, ENERGY STAR®. This measure must meet the specification requirements of 70 percent cooking energy efficiency and an idle energy rate of 1.6 kW. Standard electric convection ovens have a 65 percent cooking energy efficiency and an idle energy rate of 2 kW.[33]

High Efficiency Ice Maker. This measure uses high efficiency compressors, fan motors, and thicker insulation to achieve 15 percent more efficiency than the baseline measure, which is a conventional automatic commercial ice maker.[34]

Hot Food Holding Cabinet, ENERGY STAR®. This measure uses a maximum of 40 watts/cubic foot. The baseline measure is a conventional holding cabinet.[35]

Low Pressure Air Distribution Complex HVAC. This under-floor measure introduces air into occupancy zones at relatively low velocities. The decrease in pressure differentials and, therefore in air velocity, results in lower energy consumption by the air handlers. The baseline for this measure is a variable air volume or constant volume HVAC system.

Motor, Consortium for Energy Efficiency (CEE) Premium-Efficiency Plus. These motors (also known as "super" or "enhanced") are more efficient than standard NEMA premium efficiency motors.[36] This measure specifically relates to HVAC motors ranging from 1 HP to 200 HP.

Motor, Pump and Fan System: Variable Speed Control. This measure allows pump and fan motors to operate at a lower speed while still maintaining set points during partial load conditions. This reduces energy consumption as motor operation can vary with load rather than frequently cycling on and off at constant speed.

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31 http://www.energystar.gov/index.cfm?c=fryers.pr_fryers

32 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COG

33 http://www.energystar.gov/index.cfm?c=ovens.pr_comm_ovens

34 Consortium for Energy Efficiency (CEE); http://www.cee1.org/com/com-kit/com-kit-equip.php3

35 http://www.energystar.gov/index.cfm?c=hfhc.pr_hfhc

36 CEE motor nominal efficiencies are higher than the NEMA federal minimum efficiency levels that became effective in December 2010. On December 19, 2010, the 2007 Energy Independence and Security Act updated the minimum efficiency standards for motors, and the previous NEMA premium efficiency specifications became the federal standard.

Motor: Variable Air Volume (VAV) Box High Efficiency Electronically Commutated Motor (ECM). High efficiency fan-powered boxes prevent hot and cold spots by maintaining room air circulation while modulating supply-air temperature to match load. This measure applies to a motor efficiency upgrade. An ECM powers the fan in each VAV box. An ECM is a brushless DC motor with electronically built-in speed and torque controls, which allows the motor speed to adjust for optimal airflow. The baseline assumes a standard VAV with induction motors including silicon controlled rectifier speed control.[37]

Network PC Power Management. This software tool intelligently manages computer powers remotely and automatically across a network overnight, on weekends, and when not in use. This significantly lowers energy consumption without impacting user productivity, desktop maintenance, or upgrades. Workstations operating on a local area network or a wide area network can implement PC power-management policies across a network to maximize energy savings.

Optimized Variable Volume Lab Hood Design. This measure allows volumetric flow rate to vary, which causes a constant speed through the duct regardless of sash opening. The baseline measure is a constant volume lab hood.

Power Supply Transformer/Converter. This measure applies to the 80 PLUS performance specification requirements for power in computers and servers. 80 PLUS specifies 80 percent or greater efficiency at 20 percent, 50 percent, and 100 percent of rated load with a true power factor of 0.9 or greater.[38] The baseline assumes an 85 percent efficient power supply (>51 watts).

RE – Deciduous Trees, Thermal Wall, Windows Overhang. Shade trees, thermal walls, and overhangs passively decrease cooling loads.

Residential Refrigerator/Freezer Recycling. This refers to the environmentally-friendly disposal of unneeded appliances such as secondary refrigerators or stand-alone freezers.

Scanner, ENERGY STAR®. This measure enters a low power sleep mode after inactivity.[39]

Server Virtualization. This measure replaces multiple under-utilized servers with one server. Many data center servers operate at 10 percent capacity or less, allowing their functions to be consolidated onto one virtual server that operates in the range of 85 percent capacity. This measure applies to the plug load end use, although it has a savings effect on the cooling load by reducing power and, therefore, the heat generated by equipment.

Advanced Power Strip. Power strips with an occupancy sensor will turn power to all devices plugged into the strip on and off, such as computers, desk lights, and audio equipment, based on occupancy within the work area.

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37 LEED-qualified Justice Center, reported by DCJ.com and the Minnesota Power Incentive Program.

38 www.80PLUS.org

39 http://www.energystar.gov.au/products/scanners.html

Steam Cooker, ENERGY STAR®. This measure has a cooking efficiency of 50 percent, with idle energy rates that vary depending upon pan size.[40] The baseline efficiency is a standard commercial steam cooker with 35 percent efficiency.

Vending Miser. This measure senses occupancy and cycles the vending machine cooling off when no occupancy is detected.

Water Cooler, ENERGY STAR®. This measure provides only cold water and consumes less than 0.16 kWh per day. A unit providing hot and cold water consumes less than 1.20 kWh per day. ENERGY STAR®-qualified water coolers consume 45 percent less energy than standard models.[41]

[40] http://www.energystar.gov/index.cfm?c=steamcookers.pr_steamcookers
[41] http://www.energystar.gov/index.cfm?c=water_coolers.pr_water_coolers

HVAC

Air or Ground Source Heat Pump (ASHP or GSHP). Electric heat pumps move heat to or from the air or the ground to cool and heat a home. Table B-2.26 displays the different efficiency levels we compared for this measure. The baseline size is the same as the measure size.

Table B-2.26 ASHP or GSHP Efficiency Comparison

Measure Name	Measure Efficiency	Baseline Efficiency
Air Source Heat Pump 65 to 135 kBTU/hr - Below Standard	Below Standard Air Source Heat Pump 65 to 135 kBTU/hr - 9.5 EER, 3.0 COP	Below Standard Air Source Heat Pump 65 to 135 kBTU/hr - 9.5 EER, 3.0 COP
Air Source Heat Pump 65 to 135 kBTU/hr - Federal Standard 2010	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP
Air Source Heat Pump 65 to 135 kBTU/hr - High Efficiency	High Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 11.5 EER, 3.4 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP
Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP
Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP

Direct Expansion (DX) Package. DX systems transfer heat with a refrigerant piping circuit, compressor, and refrigerant coils. All components are in a single package typically installed on the building roof. Commercial-sized units are normally rated by their Energy Efficient Ratio (EER). Table B-2.27 displays the different models compared in this measure.

Table B-2.27 Direct Expansion Efficiency Comparison

Measure Efficiency	Baseline Efficiency
Below Standard DX Package 65 to 135 kBTU/hr - 9.5 EER	Below Standard DX Package 65 to 135 kBTU/hr - 9.5 EER
Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER
High Efficiency DX Package 65 to 135 kBTU/hr - 11.5 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER
Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER

Screw Chiller. Screw compressors are positive displacement devices. The refrigerant chamber actively compresses to a smaller volume by the twisting motion of two interlocking, rotating screws. Refrigerant trapped in the space between the two rotating screws is compressed as it travels from the inlet to the outlet of the compressor. A slide valve adjusts the compression effect by varying the amount of compression that occurs before the refrigerant is discharged. Screw chillers are generally used for small- to medium-sized buildings.

Water Heating

Water Heater, Heat Pump. This measure moves heat from a warm reservoir (such as air) into the hot water system.[42] Baseline and efficient measure EF values are given in Table B-2.28.

Table B-2.28 Heat Pump Water Heater Efficiency Comparison

Measure Efficiency	Baseline Efficiency
Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93
Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948

Water Heater, Solar. Solar Water Heaters use thermal energy to heat water without the use of electricity, gas, or heating oil.

Lighting

Lighting Interior, Screw Based. This measure upgrades screw-based lighting fixtures to a more efficient lighting technology. A lumen equivalence is used to avoid changing the lighting level by varying the number of fixtures during the upgrade process. If the lumen equivalence happens to be within 10% of the baseline lumens, however, the number of fixtures remains constant. This measure only applies to existing construction.

Lighting Interior Fluorescent. This measure upgrades fluorescent lighting fixtures to a more efficient lighting technology. A lumen equivalence is used to avoid changing the lighting level by varying the number of fixtures during the upgrade process. If the lumen equivalence happens to be within 10% of the baseline lumens, however, the number of fixtures remains constant. This measure only applies to existing construction. Table B-2.29 displays the different models compared in this measure.

Table B-2.29 Fluorescent Lighting Comparison

Measure	Baseline

42 Description source: U.S. Department of Energy; http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12840

Reduced Wattage T8	T8
High Performance T8	T8
T5	T8
LED Tube	T8

Lighting Interior High Intensity Discharge (HID) and High Bay. This measure represents upgrading HID and high-bay lighting fixtures to more efficient lighting technologies. A lumen equivalence is used to avoid changing the lighting level by varying the number of fixtures during the upgrade process. If the lumen equivalence happens to be within 10% of the baseline lumens, however, the number of fixtures remains constant. This measure only applies to existing construction. Table B-2.30 displays the different models compared in this measure.

Table B-2.30 HID and High Bay Lighting Comparison

Measure	Baseline
Efficient Metal Halide	Weighted Average of Mercury Vapor, High Pressure Sodium, and Metal Halide
LED	Weighted Average of Mercury Vapor, High Pressure Sodium, and Metal Halide
T5 High Output	Weighted Average of Mercury Vapor, High Pressure Sodium, and Metal Halide

Lighting Reduction Package, Advanced Efficiency. This measure results in a 15 percent decrease in lighting power density (W/sqft). The baseline lighting technology includes all available technologies in a building that make up the total watts per square foot. Installation of the lighting reduction package reduces lighting power density with higher efficiency technologies, such as high performance T8 or T5 tubes, high-efficiency ballasts, reflective lighting fixtures, etc.

Lighting Reduction Package, High Efficiency. This measure results in a 20 percent decrease in lighting power density (W/sqft). The baseline lighting technology includes all available technologies in a building that make up the total watts per square foot. Installation of the lighting reduction package reduces lighting power density with higher efficiency technologies, such as high performance T8 or T5 tubes, high-efficiency ballasts, reflective lighting fixtures, etc.

Lighting Reduction Package, Premium Efficiency. This measure results in a 25 percent decrease in lighting power density (W/sqft). The baseline lighting technology includes all available technologies in a building that make up the total watts per square foot. Installation of the lighting reduction package reduces lighting power density (W/sqft) with higher efficiency technologies, such as high performance T8 or T5 tubes, high-efficiency ballasts, reflective lighting fixtures, etc.

Other

Computer, ENERGY STAR. This measure consumes less than 2 watts in sleep and off modes, and is more efficient than conventional units in idle mode, resulting in 30 to 65 percent energy savings.

Copiers, ENERGY STAR. ENERGY STAR copiers deliver the same performance as conventional equipment, and are, on average, 27% more efficient, and power down when not in use. The baseline measure is a non-ENERGY STAR copier.[43]

Fax, ENERGY STAR. ENERGY STAR fax machines enter sleep mode after inactivity, reducing their total power consumption by 50%.[44]

Freezer. ENERGY STAR-qualified freezers use at least 10% less energy than standard models due to improvements in insulation and compressors. This measure considers the change in 2015 federal standard efficiency levels and three RTF tiers, ranging from 10% to 35% more efficient than the 2001 federal standard.

Monitor, Energy Star. ENERGY STAR monitors feature the following: (1) an "on" mode, where the maximum allowed power varies, based on the computer monitor's resolution; (2) a "sleep" mode, where computer monitor models must consume 2 watts or less; and (3) an "off" mode, where computer monitor models must consume 1 watt or less. The baseline equipment does not include these features.[45]

Printer, Energy Star. ENERGY STAR printers deploy a maximum time delay to sleep, depending upon the equipment's size. This reduces power consumption during inactive periods, resulting in 37% energy savings.[46]

Refrigerator. ENERGY STAR and CEE-qualified refrigerators use at least 20% less energy than standard models, due to improvements in insulation and compressors. This measure considers the change in 2015 federal standard efficiency, and two RTF and two CEE tiers above ENERGY STAR. Table B-2.31 shows baseline and efficient measures.

Table B-2.31 Refrigerator Efficiency Comparison

Measure Efficiency	Baseline Efficiency
RTF Tier 1 (ENERGY STAR) Refrigerator	RTF Market Standard Refrigerator
RTF Tier 2 Refrigerator	RTF Market Standard Refrigerator
RTF Tier 3 Refrigerator	RTF Market Standard Refrigerator
ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator

Server, High Efficiency. ENERGY STAR High Efficiency servers use 23 percent less energy than standard servers due to more efficient power suppliers, better voltage regulators, advanced professors, and more efficient fans.[47]

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43 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CP
44 http://www.energystar.gov/ia/products/fap/IE_Prog_Req.pdf
45 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.ShowProductGroup&pgw_code=MO
46 http://www.energystar.gov/ia/products/fap/IE_Prog_Req.pdf

Vending Machines, High Efficiency. ENERGY STAR High Efficiency Vending Machines use more efficient compressors, fan motors, and lighting systems than standard vending machines, and also come equipped with low power modes.[48]

[47] https://www.energystar.gov/index.cfm?c=power_mgt.datacenter_efficiency_purchasing
[48] http://www.energystar.gov/products/certified-products/detail/vending-machines

Commercial Gas Retrofit Measure Descriptions

HVAC (and Envelope)

Automated Ventilation Variable Frequency Drive (VFD) Control, Occupancy/CO_2 sensors. This measure is also known as demand-control ventilation (DCV), where the ventilation system automatically adjusts air flow when CO_2 is above a specified level. CO_2 controls maintain a minimum ventilation rate at all times to control non-occupant contaminants, such as off-gassing from furniture, equipment, and building components. The baseline of this measure is a ventilation system that runs constantly.

Boiler Economizer. This measure recovers heat energy that would otherwise be lost out the boiler stack by using a heat exchanger located on the stack to preheat boiler feed water.

Convert Constant Volume Air System to Variable Air Volume (VAV). This measure allows the airflow volume of a HVAC system to vary the heating or cooling load rather than over-conditioning and short-cycling. The baseline is a constant volume system.

Direct Digital Control (DDC) System, Installation. DDC systems allow for both HVAC and lighting to be controlled and monitored. For lighting, the DDC system allows for direct control of lights from a remote location. Entire HVAC systems, including pumps, motors, fans, and set points, can be digitally programmed for tighter control of the system.

Direct Digital Control (DDS) System, Wireless Performance Monitoring. This second-generation building automation systems allows for wireless optimization and operation of building systems (such as HVAC) through computerized monitoring and control software and interfaces.

Duct Fittings, Leak-Proof. The majority of duct leakage in residential HVAC systems is due to improperly sealed connections between ductwork and fittings. Even when duct connections are initially well-sealed, leakage may increase over time.

Duct Repair and Sealing. This maintenance creates significant energy savings by ensuring conditioned air only goes to occupied spaces, thereby reducing an excessive runtime/load on the HVAC system.

Exhaust Air to Ventilation Air Heat Recovery. This measure captures heated air exhausted out of a building and transfers it to the incoming air, decreasing the overall heating load.

Exhaust Hood Makeup Air. This measure provides exhaust air at the hood instead of allowing the hood to exhaust conditioned air in the room. The baseline measure is for conditioned air to be expelled through exhaust hoods.

Infiltration Reduction (Caulking, Weather Stripping, etc.). Sealing air leaks in windows, doors, the roof, crawlspaces, and outside walls decreases overall heating and cooling losses. This measure reduces the number of air changes per hour from 1.00 to 0.65.

Insulation, Ceiling. These measures represent an increase in R-value from existing building conditions to current state code or from current state code to better than code. Baseline and measure values are presented in Table B-2.32.

Table B-2.32 Ceiling Insulation Efficiency Comparison

Measure Efficiency	Baseline Efficiency
R-38 c.i.	R-30 c.i. (WA State Code)
R-49 c.i.	R-38 c.i.
R-30 c.i. (WA State Code)	Average Existing Conditions

Insulation, Duct. Packaged direct expansion and heat-pump equipment are generally coupled with a ducting system inside the building. Insulating these ducts reduces energy loss to the unconditioned plenum space. This measure assumes that R-7 insulation is installed where no insulation previously existed.

Insulation, Floor (Non-Slab). These measures represent an increase in R-value from existing building conditions to current state code or from current state code to better than code. Baseline and measure values are presented in Table B-2.33.

Table B-2.33 Floor (Non-Slab) Efficiency Comparison

Measure Efficiency	Baseline Efficiency
R-30 (WA State Code)	Average Existing Conditions
R-38	R-30 (WA State Code)

Insulation, Wall. These measures represent an increase in R-value from existing building conditions to the current state code value of R-13 + 7.5. The baseline value of R-3 represents the average existing insulation level.

Programmable Thermostat, Web Enabled. This measure controls set point temperature automatically, ensuring the HVAC system is not running during low-occupancy hours.

RE Thermal Wall. Thermal walls use passive shading to decrease cooling needs, saving at least 2 percent of energy per building. The baseline efficiency is conventional wall construction.

Retro-Commissioning. Commissioning ensures that energy-using systems are operating in an optimal fashion in order to maximize energy efficiency. This commissioning process can be applied to existing buildings to restore them to optimal performance. Retro-commissioning is a systematic, documented process that identifies low-cost operational and maintenance improvements in existing buildings and brings them up to the design intentions.[49,50] The baseline measure is no commissioning.

Sensible Heat Recovery Devices. This measure preconditions incoming air by transferring energy between the exhaust air stream and the supply air stream. This raises the temperature of incoming air during the winter and decreases it in the summer. Energy savings results from the reduced need for mechanical heating or cooling.

Total Heat Recovery Devices. This measure, also called enthalpy recovery, transfers sensible and latent heat. Latent heat, which is released or absorbed due to a phase change (such as the condensation of water vapor), significantly raises the outdoor air humidity in the winter and reduces it in the summer.[51]

Steam Pipe Insulation. R-4 insulation reduces heat loss from a steam pipe. The loss size depends on the pipe diameter and steam temperature.

Windows, High Efficiency. This measure increases building performance by reducing the U-value, as shown in Table B-2.34.

Table B-2.34 Windows Efficiency Comparison

Measure Efficiency	Baseline Efficiency
U-0.32	U-0.40 (WA State Code)
U-0.40 (WA State Code)	Average Existing Conditions

Water Heat

Clothes Washer, Ozonating. This measure disinfects water with ozone-enriched air, which suppresses subsequent biological activity and controls biological growth within the appliance, thus reducing the need for hot water. The baseline measure is a standard commercial clothes washer.[52]

Clothes Washer, Commercial. ENERGY STAR qualified commercial washers have a greater capacity than conventional top-load models with an agitator. Some front-loaders can wash over 20 pounds of laundry at once, compared to 10–15 pounds for a standard top-loader. This means residents can do fewer loads. and avoid having to bring big, bulky items to the Laundromat.[53] This measure replaces a clothes washer, having a Modified Energy Factor (MEF) of 1.60, with an ENERGY STAR model assigned a MEF value of 2.43.

49 http://www.green.ca.gov/CommissioningGuidelines/default.htm

50 http://cbs.lbl.gov/BPA/cct.html

51 http://www.mcquay.com/mcquaybiz/marketing_tools/mt_corporate/EngNews/0701.pdf

52 http://www.patentstorm.us/patents/6607672-description.html

53 http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers_comm

Demand-Controlled Circulating Systems. This measure circulates hot water only when required. The baseline measure is a continuously circulating hot water system, resulting in energy loss through pipes.

Dishwasher, Commercial: High Temperature ENERGY STAR®. This measure has a minimal idle rate, consumes a minimal amount of water per rack of loaded dishes, and is on average 25 percent more efficient than standard high temp commercial dishwashers.[54]

Dishwasher, Commercial: Low Temperature ENERGY STAR®. This measure uses chemicals combined with low temperatures to save energy compared to standard high temperature commercial dishwashers.

Dishwasher, Residential ENERGY STAR®. Residential sized ENERGY STAR® dishwashers are often appropriate for smaller commercial buildings, and are 10 percent more efficient than the federal minimum standard used as the baseline.[55]

Drain Water Heat Recovery, Water Heater. This measure recovers heat energy from drain water and uses it to heat water entering the hot water tank, minimizing the temperature rise required to achieve the water heater set point.[56]

Hot Water (SHW) Pipe Insulation. One inch of extra insulation on hot water pipes yields an approximate R-value of R-4, decreasing temperature losses. This measure is only applicable for existing construction. The baseline measure is no insulation.

Integrated Space Heating/Water Heating. These systems provide space conditioning and hot water heating in one appliance/energy source. Domestic hot water is heated directly and space is heated by a hot water heat exchanger coil piped to the forced air heating system. This combination space/water heating system provides high efficiency heating for the cost of one high efficiency appliance.

Low-Flow Faucet Aerators. This measure mixes water and air, reducing the amount of water that flows through the faucet. It creates a fine water spray through an inserted screen in the faucet head. Flow rate requirements for this measure are presented in in Table B-2.35.

Table B-2.35 Low Flow Faucet Aerators Efficiency Comparison

Measure Efficiency	Baseline Efficiency
1.5 GPM	2.2 GPM (Federal Code)
2.2 GPM (Federal Code)	3.0 GPM
1.0 GPM	2.2 GPM (Federal Code)
0.5 GPM	2.2 GPM (Federal Code)

[54] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COH
[55] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=DW
[56] www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=858&BucketID=6&CategoryID=9

Low-Flow Pre-Rinse Spray Valves. This measure mixes water and air, reducing the amount of water that flows through the spray head. The head creates a fine water spray through an inserted screen, achieving a flow reduction from 1.6 GPM (federal standard) to 0.6 GPM.

Low-Flow Showerheads. Low-flow showerheads mix water and air to reduce the amount of water that flows through the showerhead. The showerhead creates a fine water spray through an inserted screen in the showerhead. Flow rate requirements for this measure are presented in in Table B-2.36.

Table B-2.36 Low-Flow Showerhead Efficiency Comparison

Measure Efficiency	Baseline Efficiency
2.0 GPM	2.5 GPM (Federal Code)
2.5 GPM (Federal Code)	3.0 GPM
1.75 GPM	2.5 GPM (Federal Code)
1.5 GPM	2.5 GPM (Federal Code)

Ultrasonic Faucet Control. Ultrasonic sensors automatically turn faucet water on and off when motion is detected at the sink. This eliminates water running continuously while the sink is in use.

Water Cooled Refrigeration with Heat Recovery. Heat recovery gathers and uses thermal energy for the water heater that would normally be rejected to the ambient environment.

Other

Broiler. High efficiency broiler ovens have rigorous start-up, shut down, and turn down schedules for additional energy savings over standard units. Improved efficiency broilers have an efficiency of 34 percent, compared to baseline models at 15 percent.

Convection Oven, High Efficiency ENERGY STAR®. This measure must meet the specification requirements of 70 percent cooking energy efficiency and an idle energy rate of 18,000 Btu/h. Standard electric convection ovens have a 65 percent cooking energy efficiency and an idle energy rate of 13,000 Btu/h.[57]

Fryers, Commercial Gas Cooking ENERGY STAR®. These measures are 50 percent efficient, and when idle use less than 9,000 Btu/hr.[58] The baseline efficiency is 35 percent for a non-ENERGY STAR® commercial fryer.

Griddle, ENERGY STAR®. This measure is approximately 10 percent more efficient than standard models, and must have a minimum cooking efficiency of 38 percent. They must use less than 0.026 therm/hour/ft^2 when idle. The baseline measure is a standard grill at 32 percent efficiency.[59]

57 http://www.energystar.gov/index.cfm?c=ovens.pr_comm_ovens
58 http://www.energystar.gov/index.cfm?c=fryers.pr_fryers

Oven, Conveyor. A high efficiency conveyor oven is 23 percent efficient, compared to a standard conveyor oven with 15 percent efficiency.

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Steam Cooker, ENERGY STAR®. This measure has a cooking efficiency of 50 percent, with idle energy rates that vary depending upon pan size.[60] The baseline efficiency is a standard commercial steam cooker with 35 percent efficiency.

Swimming Pool/Spa Covers. This measure reduces evaporation, which is the largest source of pool/spa energy loss. It takes one British thermal unit (Btu) to raise one pound of water by one degree. Each pound of 80º F water that evaporates takes 1,048 Btus of heat out of the pool.[61] The baseline measure is an uncovered pool or spa.

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59 http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COG
60 http://www.energystar.gov/index.cfm?c=steamcookers.pr_steamcookers
61 http://www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=13140

Commercial Gas Equipment Measure Descriptions

HVAC

Gas Boiler. Boilers are classified as condensing or non-condensing. Condensing boilers condense the flue gas and water vapor, extracting useful heat and improving the boiler efficiency. This measure compares several boilers with different thermal efficiencies and is applicable to both new and existing construction. The overall efficiency of the boiler is defined as the gross energy output divided by the energy input, and is affected by combustion efficiency, standby losses, cycling losses, and heat transfer. Table B-2.37 displays the measure and baseline thermal efficiencies.

Table B-2.37 Gas Boiler Efficiency Comparison

Measure Efficiency	Baseline Efficiency
Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency
Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency

Gas Furnace. Improvements in furnace technology, such as new ignition and heat exchange design, have led to increased furnace efficiency. The AFUE levels considered in this measure are shown in Table B-2.38.

Table B-2.38 Gas Furnace Efficiency Comparison

Measure Efficiency	Baseline Efficiency
High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE
High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE
ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE

Water Heat

Water Heater. This measure has a range of thermal efficiencies as shown in Table B-2.39. High efficiency models have better insulation, which reduces standby losses.

Table B-2.39 Water Heater Efficiency Comparison

Measure Efficiency	Baseline Efficiency
Federal Standard 2015 Storage Water Heater - EF 0.615	Federal Standard 2015 Storage Water Heater - EF 0.615
ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615
ENERGY STAR Tankless Water	Federal Standard 2015 Storage

Measure Efficiency	Baseline Efficiency
Heater - EF 0.82	Water Heater - EF 0.615
Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615

Other

RE - Installation of Solar Pool/Spa Heating Systems. Solar pool and spa heating systems use thermal energy instead of gas to regulate pool and spa temperatures, eliminating the need for gas heating in the spa system. The baseline comparison is standard pool heat equipment.

Industrial Electric Measure Descriptions

Air Compressor Improvements (Demand Reduction, Optimization, Equipment). These measures improve the overall compressed air system by improved system design, leak repair, usage practices, more efficient dryer and storage systems, and compressor upgrades.

Clean Room Improvements (Change Filter Strategy, Chiller Optimize, HVAC). These measures aim to save energy through improved clean room equipment and practices. Savings are attributable to optimization of chiller operating parameters, upgrading to more efficient equipment, and improving filter replacement strategies.

Efficiency Centrifugal Fan. This measure achieves energy savings through improved fan design.

Fan System Optimization. This measure involves the overall optimization of the fan system with improved system design, enhanced flow design, better maintenance practices, and adjustments to system parameters.

Food Manufacturing (Cooling and Storage, Refrigerator Storage Tune-up). These measures maintain and enhance the cooling equipment for each facility type. Tune-ups may include refrigerant charge, equipment cleaning, general maintenance, and improved practices.

General Process Improvements (Paper: Premium Fan, Paper: Large Material Handling, Paper: Material Handling, Paper: Premium Control Large Material, Efficient Pulp Screen, Wood: Replace Pneumatic Conveyor, Metal: New Arc Furnace). These measures include upgrading equipment, replacing hydraulic/pneumatic equipment with electrical equipment, and using optimum size and capacity equipment.

High Efficiency Fans (Fan Equipment Upgrade). This measure involves upgrading motors to higher efficiency. Since NEMA Premium motors are becoming the baseline code requirement in 2010, this measure is based off of super premium motors with efficiency levels at least one efficiency band above NEMA premium.

Light Emitting Diode (LED) Street Light Conversions. LED street lights can replace standard high-pressure sodium (HPS) street lights, with similar lumens achieved with less wattage.

Lighting Improvements (Efficient Lighting 1, 2, and 3 Shift; HighBay Lighting 1, 2, and 3 Shift; Lighting Controls). Changes to overall illumination levels, use of natural lighting, or technology improvements to more efficient bulbs or ballasts will decrease the overall lighting energy consumption. These measures include upgrades from T12 to T8 systems, T8 to high-performance T8 systems, HID to fluorescent conversions, standard HID to high-efficiency HID systems, and occupancy and day lighting controls.

Material Handling (Material Handling Variable Speed Drive (VFD) 1 and 2, Material Handling 1 and 2). This measure includes equipment upgrades (such as to VSDs) and enhanced system design or practices.

Motor Rewind. This measure follows the Green Motors Practices Group™ recommendations of best practices to maintain original efficiency, commonly called a Green Rewind.[62, 63] A failed motor can be rewound to a lower efficiency, rewound to maintain the original efficiency, or replaced.

Pump Equipment Upgrade. This measure achieves energy savings through improved pump design and sizing.

Pump Improvements (Pump Energy Management, Pump System Optimization). This measure involves optimizing the overall pump system with improved system design, enhanced flow design, better maintenance practices, and adjustments to system parameters.

Synchronous Belts. This measure contains mating, corresponding grooves in the drive sprocket, preventing slip and thus reducing energy losses.

Transformers (New & Retrofit). Energy efficient transformers provide improved power quality while minimizing losses.

Whole Plant Improvements (Fan Energy Management, Plant Energy Management, Integrated Plant Energy Management, Energy Project Management). These measures include synergistic savings of plant-wide energy management and improvements across multiple systems such as compressed air, pumping, and fan systems.

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62 http://www.bpa.gov/energy/n/industrial/Green_motors/

63 http://www.greenmotors.org/downloads/RTFSubmittalMay_08%20_2_.pdf

Industrial Gas Measure Descriptions

Boiler Improvements. A boiler generally creates steam or hot water for process or non-process applications. Savings are generated by installation of a waste heat boiler to provide direct power or use of flue gas heat to preheat boiler feed water.

Boiler Operation and Maintenance. This measure includes analyzing flue gas for proper air/fuel ration, establishing maintenance schedules, or reducing excessive boiler blow down.

HVAC Improvements. Many measures can reduce a plants' HVAC energy consumption, such as conditioning only space in use, installing timers and/or thermostats, lowering ceilings to reduce conditioned space, and installing or upgrading insulation on distribution systems.

HVAC Operation and Maintenance. These measures include sizing air handling grills/ducts/coils to minimize air resistance, adjusting vents to minimize energy use, and maintaining air filters by cleaning or replacing.

Other Process Improvements/Operation and Maintenance. These measures include upgrading obsolete equipment, reducing fluid flow rates, and using optimum size and capacity equipment.

Process Heating Improvements. These measures decrease the energy required for process-related heating. Examples include optimizing the drying oven schedule, reducing the temperature of process equipment when on standby, and modifying equipment to improve the drying process.

Process Heating Operation and Maintenance. These measures improve overall energy efficiency. Examples include repairing faulty insulation, adjusting burners for efficient operation, and eliminating leaks in combustible gas lines.

Steam Distribution Systems. These measures include leak elimination and improved duct insulation to reduce distribution system loss.

Appendix B.3: Measure Details

The following tables show electric and gas technical measure inputs for the residential, commercial, and industrial sectors.

Table 1 – Residential Electric Measures Detail

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Manufactured	Air Purifier	Equipment	Air Purifier - ENERGY STAR	ENERGY STAR Air Purifier	Standard Air Purifier	Existing	Per Air Purifier	391	9	$10.00	100%	75%	-$0.02	161
Electric	Energy Efficiency	Manufactured	Air Purifier	Equipment	Air Purifier - ENERGY STAR	ENERGY STAR Air Purifier	Standard Air Purifier	New	Per Air Purifier	391	9	$10.00	100%	75%	-$0.02	64
Electric	Energy Efficiency	Manufactured	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	Existing	Per Cooking Oven	3	20	$282.71	100%	95%	$11.46	32
Electric	Energy Efficiency	Manufactured	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	New	Per Cooking Oven	3	20	$282.71	100%	95%	$11.46	21
Electric	Energy Efficiency	Manufactured	Cool Central	Equipment	Central Air Conditioner - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Central Air Conditioner SEER/EER 18/13 (Split System)	Federal Standard 2015 Central Air Conditioner SEER/EER 13/11.2 (Split System)	Existing	Per Central AC	69	15	$1,788.00	100%	94%	$3.31	491
Electric	Energy Efficiency	Manufactured	Cool Central	Equipment	Central Air Conditioner - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Central Air Conditioner SEER/EER 18/13 (Split System)	Federal Standard 2015 Central Air Conditioner SEER/EER 13/11.2 (Split System)	New	Per Central AC	55	15	$1,490.00	100%	94%	$3.44	155
Electric	Energy Efficiency	Manufactured	Cool Room	Equipment	Room AC - ENERGY STAR	ENERGY STAR Room AC - CEER 11.3 (8,000-13,999 Btuh)	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	Existing	Per Room AC	10	9	$80.23	100%	49%	$1.36	17
Electric	Energy Efficiency	Manufactured	Cool Room	Equipment	Room AC - ENERGY STAR	ENERGY STAR Room AC - CEER 11.3 (8,000-13,999 Btuh)	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	New	Per Room AC	8	9	$80.23	100%	49%	$1.60	5
Electric	Energy Efficiency	Manufactured	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced - EFficiency Dryer - EF 4.10	Federal Standard 2015 Dryer - CEF 3.73	Existing	Per Dryer	56	11	$99.82	100%	100%	$0.25	2,087
Electric	Energy Efficiency	Manufactured	Dryer	Equipment	Dryer - Heat Pump Dryer	Premium Efficiency - Heat Pump Dryer (0.23 kWh/kg Clothing)	Federal Standard 2015 Dryer - CEF 3.73	Existing	Per Dryer	375	16	$416.53	25%	100%	$0.12	5,946
Electric	Energy Efficiency	Manufactured	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced - EFficiency Dryer - EF 4.10	Federal Standard 2015 Dryer - CEF 3.73	New	Per Dryer	56	11	$99.82	100%	100%	$0.25	779
Electric	Energy Efficiency	Manufactured	Dryer	Equipment	Dryer - Heat Pump Dryer	Premium Efficiency - Heat Pump Dryer (0.23 kWh/kg Clothing)	Federal Standard 2015 Dryer - CEF 3.73	New	Per Dryer	375	16	$416.53	25%	100%	$0.12	2,076
Electric	Energy Efficiency	Manufactured	Freezer	Equipment	Freezer - RTF Tier 3	30%+ More Efficient Than Federal Standard	RTF Market Standard Freezer	Existing	Per Freezer	119	20	$191.60	100%	100%	$0.17	392
Electric	Energy Efficiency	Manufactured	Freezer	Equipment	Freezer - RTF Tier 3	30%+ More Efficient Than Federal Standard	RTF Market Standard Freezer	New	Per Freezer	119	20	$191.60	100%	100%	$0.17	867
Electric	Energy Efficiency	Manufactured	Heat Pump	Equipment	Heat Pump - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Heat Pump - SEER/EER 18/12.5 and HSPF 9.6 (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)	Existing	Per Heat Pump	894	20	$2,685.98	100%	99%	$0.31	1,863
Electric	Energy Efficiency	Manufactured	Heat Pump	Equipment	Heat Pump - Ground Source	ENERGY STAR Ground Source Heat Pump - EER 17.1 and 3.6 COP (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)	Existing	Per Heat Pump	1659	20	$10,009.67	25%	99%	$0.65	1,134

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Manufactured	Heat Pump	Equipment	Heat Pump - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Heat Pump - SEER/EER 18/12.5 and HSPF 9.6 (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)	New	Per Heat Pump	490	20	$2,079.47	100%	100%	$0.45	598
Electric	Energy Efficiency	Manufactured	Heat Pump	Equipment	Heat Pump - Ground Source	ENERGY STAR Ground Source Heat Pump - EER 17.1 and 3.6 COP (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)	New	Per Heat Pump	903	20	$7,749.42	25%	100%	$0.93	362
Electric	Energy Efficiency	Manufactured	Lighting Exterior	Equipment	CFL	CFL	Incandescent - EISA Standard	Existing	Per Lamp (Exterior)	48	4	$1.12	92%	33%	-$0.01	181
Electric	Energy Efficiency	Manufactured	Lighting Exterior	Equipment	LED	LED	Incandescent - EISA Standard	Existing	Per Lamp (Exterior)	59	12	$11.05	8%	95%	$0.01	84
Electric	Energy Efficiency	Manufactured	Lighting Exterior	Equipment	CFL	CFL	Incandescent - EISA Standard	New	Per Lamp (Exterior)	48	4	$1.12	92%	33%	-$0.01	100
Electric	Energy Efficiency	Manufactured	Lighting Exterior	Equipment	LED	LED	Incandescent - EISA Standard	New	Per Lamp (Exterior)	59	12	$11.05	8%	95%	$0.01	79
Electric	Energy Efficiency	Manufactured	Lighting Interior Specialty	Equipment	CFL - Specialty	CFL - Specialty	Incandescent - Specialty	Existing	Per Lamp (Interior Specialty)	31	8	$1.28	45%	75%	-$0.01	781
Electric	Energy Efficiency	Manufactured	Lighting Interior Specialty	Equipment	LED - Specialty	LED - Specialty	Incandescent - Specialty	Existing	Per Lamp (Interior Specialty)	36	12	$11.88	55%	98%	$0.03	5,020
Electric	Energy Efficiency	Manufactured	Lighting Interior Specialty	Equipment	CFL - Specialty	CFL - Specialty	Incandescent - Specialty	New	Per Lamp (Interior Specialty)	31	8	$1.28	45%	75%	-$0.01	432
Electric	Energy Efficiency	Manufactured	Lighting Interior Specialty	Equipment	LED - Specialty	LED - Specialty	Incandescent - Specialty	New	Per Lamp (Interior Specialty)	36	12	$11.88	55%	98%	$0.03	1,862
Electric	Energy Efficiency	Manufactured	Lighting Interior Standard	Equipment	LED	LED	Incandescent - EISA Standard	Existing	Per Lamp (Interior Standard)	22	12	$11.05	75%	95%	$0.06	4,924
Electric	Energy Efficiency	Manufactured	Lighting Interior Standard	Equipment	LED	LED	Incandescent - EISA Standard	New	Per Lamp (Interior Standard)	22	12	$11.05	75%	95%	$0.06	1,187
Electric	Energy Efficiency	Manufactured	Refrigerator	Equipment	Refrigerator - RTF Tier 3	30%+ more efficient than Federal Standard 2014 Refrigerator	RTF Market Baseline Refrigerator	Existing	Per Refrigerator	111	17	$98.32	100%	100%	$0.09	3,531
Electric	Energy Efficiency	Manufactured	Refrigerator	Equipment	Refrigerator - RTF Tier 3	30%+ more efficient than Federal Standard 2014 Refrigerator	RTF Market Baseline Refrigerator	New	Per Refrigerator	111	17	$98.32	100%	100%	$0.09	2,153
Electric	Energy Efficiency	Manufactured	Ventilation And Circulation	Equipment	Motor - ECM	ECM Motor	Standard Motor	Existing	Per Motor (Ventilation and Circulation)	352	20	$172.26	50%	80%	$0.03	484
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 2.05	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	54	15	$681.20	60%	100%	$1.58	43
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	80	15	$505.75	60%	100%	$0.78	179
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	616	15	$6,307.25	5%	100%	$1.28	110
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	1151	20	$4,874.83	15%	100%	$0.47	774
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 2.05	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	54	15	$681.20	60%	100%	$1.58	11
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	80	15	$505.75	60%	100%	$0.78	48
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	616	15	$6,307.25	5%	100%	$1.28	35

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	1151	20	$4,874.83	15%	100%	$0.47	235
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 1.43	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	1254	15	$1,069.54	60%	100%	$0.11	8,418
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	2024	15	$1,605.29	60%	100%	$0.10	41,194
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Water Heater - RTF Market Standard Storage	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	2306	20	$5,999.89	15%	0%	$0.29	9,494
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	2536	15	$7,432.31	5%	100%	$0.37	4,797
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 1.43	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	1254	15	$1,069.54	60%	100%	$0.11	3,213
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	2024	15	$1,605.29	60%	100%	$0.10	15,719
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	2306	20	$5,999.89	15%	100%	$0.29	6,172
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	2536	15	$7,432.31	5%	100%	$0.37	1,883
Electric	Energy Efficiency	Multifamily	Air Purifier	Equipment	Air Purifier - ENERGY STAR	ENERGY STAR Air Purifier	Standard Air Purifier	Existing	Per Air Purifier	391	9	$10.00	100%	75%	-$0.02	909
Electric	Energy Efficiency	Multifamily	Air Purifier	Equipment	Air Purifier - ENERGY STAR	ENERGY STAR Air Purifier	Standard Air Purifier	New	Per Air Purifier	391	9	$10.00	100%	75%	-$0.02	359
Electric	Energy Efficiency	Multifamily	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	Existing	Per Cooking Oven	3	20	$282.71	100%	95%	$11.46	115
Electric	Energy Efficiency	Multifamily	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	New	Per Cooking Oven	3	20	$282.71	100%	95%	$11.46	76
Electric	Energy Efficiency	Multifamily	Cool Central	Equipment	Central Air Conditioner - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Central Air Conditioner SEER/EER 18/13 (Split System)	Federal Standard 2015 Central Air Conditioner SEER/EER 13/11.2 (Split System)	Existing	Per Central AC	66	15	$774.80	100%	100%	$1.48	793
Electric	Energy Efficiency	Multifamily	Cool Central	Equipment	Central Air Conditioner - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Central Air Conditioner SEER/EER 18/13 (Split System)	Federal Standard 2015 Central Air Conditioner SEER/EER 13/11.2 (Split System)	New	Per Central AC	63	15	$655.60	100%	100%	$1.31	279
Electric	Energy Efficiency	Multifamily	Cool Room	Equipment	Room AC - ENERGY STAR	ENERGY STAR Room AC - CEER 11.3 (8,000-13,999 Btuh)	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	Existing	Per Room AC	4	9	$80.23	100%	49%	$3.72	12
Electric	Energy Efficiency	Multifamily	Cool Room	Equipment	Room AC - ENERGY STAR	ENERGY STAR Room AC - CEER 11.3 (8,000-13,999 Btuh)	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	New	Per Room AC	3	9	$80.23	100%	49%	$3.85	4
Electric	Energy Efficiency	Multifamily	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced - EFficiency Dryer - EF 4.10	Federal Standard 2015 Dryer - CEF 3.73	Existing	Per Dryer	56	11	$99.82	100%	100%	$0.25	6,233
Electric	Energy Efficiency	Multifamily	Dryer	Equipment	Dryer - Heat Pump Dryer	Premium Efficiency - Heat Pump Dryer (0.23 kWh/kg Clothing)	Federal Standard 2015 Dryer - CEF 3.73	Existing	Per Dryer	375	16	$416.53	25%	100%	$0.12	17,757
Electric	Energy Efficiency	Multifamily	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced - EFficiency Dryer - EF 4.10	Federal Standard 2015 Dryer - CEF 3.73	New	Per Dryer	56	11	$99.82	100%	100%	$0.25	2,327
Electric	Energy Efficiency	Multifamily	Dryer	Equipment	Dryer - Heat Pump Dryer	Premium Efficiency - Heat Pump Dryer (0.23 kWh/kg Clothing)	Federal Standard 2015 Dryer - CEF 3.73	New	Per Dryer	375	16	$416.53	25%	100%	$0.12	6,199
Electric	Energy Efficiency	Multifamily	Freezer	Equipment	Freezer - RTF Tier 3	30%+ More Efficient Than Federal	RTF Market Standard Freezer	Existing	Per Freezer	119	20	$191.60	100%	100%	$0.17	1,096

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						Standard										
Electric	Energy Efficiency	Multifamily	Freezer	Equipment	Freezer - RTF Tier 3	30%+ More Efficient Than Federal Standard	RTF Market Standard Freezer	New	Per Freezer	119	20	$191.60	100%	100%	$0.17	724
Electric	Energy Efficiency	Multifamily	Heat Pump	Equipment	Heat Pump - Advanced	Advanced Heat Pump - SEER/EER 16/12.5 and HSPF 10 (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)	Existing	Per Heat Pump	886	20	$559.04	100%	100%	$0.04	315
Electric	Energy Efficiency	Multifamily	Heat Pump	Equipment	Heat Pump - Ground Source	ENERGY STAR Ground Source Heat Pump - EER 17.1 and 3.6 COP (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)	Existing	Per Heat Pump	1379	20	$3,551.81	25%	100%	$0.26	164
Electric	Energy Efficiency	Multifamily	Heat Pump	Equipment	Heat Pump - Advanced	Advanced Heat Pump - SEER/EER 16/12.5 and HSPF 10 (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)	New	Per Heat Pump	633	20	$508.22	100%	100%	$0.06	159
Electric	Energy Efficiency	Multifamily	Heat Pump	Equipment	Heat Pump - Ground Source	ENERGY STAR Ground Source Heat Pump - EER 17.1 and 3.6 COP (Split System)	Federal Standard 2015 Heat Pump - SEER/EER 14/12 and HSPF 8.2 (Split System)	New	Per Heat Pump	991	20	$3,228.92	25%	100%	$0.33	83
Electric	Energy Efficiency	Multifamily	Lighting Exterior	Equipment	CFL	CFL	Incandescent - EISA Standard	Existing	Per Lamp (Exterior)	48	4	$1.12	92%	30%	-$0.01	399
Electric	Energy Efficiency	Multifamily	Lighting Exterior	Equipment	LED	LED	Incandescent - EISA Standard	Existing	Per Lamp (Exterior)	59	12	$11.05	8%	97%	$0.01	485
Electric	Energy Efficiency	Multifamily	Lighting Exterior	Equipment	CFL	CFL	Incandescent - EISA Standard	New	Per Lamp (Exterior)	48	4	$1.12	92%	30%	-$0.01	216
Electric	Energy Efficiency	Multifamily	Lighting Exterior	Equipment	LED	LED	Incandescent - EISA Standard	New	Per Lamp (Exterior)	59	12	$11.05	8%	97%	$0.01	243
Electric	Energy Efficiency	Multifamily	Lighting Interior Specialty	Equipment	CFL - Specialty	CFL - Specialty	Incandescent - Specialty	Existing	Per Lamp (Interior Specialty)	31	8	$1.28	45%	64%	-$0.01	1,096
Electric	Energy Efficiency	Multifamily	Lighting Interior Specialty	Equipment	LED - Specialty	LED - Specialty	Incandescent - Specialty	Existing	Per Lamp (Interior Specialty)	36	12	$11.88	55%	98%	$0.03	19,436
Electric	Energy Efficiency	Multifamily	Lighting Interior Specialty	Equipment	CFL - Specialty	CFL - Specialty	Incandescent - Specialty	New	Per Lamp (Interior Specialty)	31	8	$1.28	45%	64%	-$0.01	529
Electric	Energy Efficiency	Multifamily	Lighting Interior Specialty	Equipment	LED - Specialty	LED - Specialty	Incandescent - Specialty	New	Per Lamp (Interior Specialty)	36	12	$11.88	55%	98%	$0.03	7,208
Electric	Energy Efficiency	Multifamily	Lighting Interior Standard	Equipment	LED	LED	Incandescent - EISA Standard	Existing	Per Lamp (Interior Standard)	22	12	$11.05	75%	95%	$0.06	10,317
Electric	Energy Efficiency	Multifamily	Lighting Interior Standard	Equipment	LED	LED	Incandescent - EISA Standard	New	Per Lamp (Interior Standard)	22	12	$11.05	75%	95%	$0.06	2,589
Electric	Energy Efficiency	Multifamily	Microwave	Equipment	Microwave - High Efficiency	High Efficiency Microwave	Federal Standard 2016 Microwave	Existing	Per Microwave Oven	10	20	$79.60	100%	98%	$0.92	563
Electric	Energy Efficiency	Multifamily	Microwave	Equipment	Microwave - High Efficiency	High Efficiency Microwave	Federal Standard 2016 Microwave	New	Per Microwave Oven	10	20	$79.60	100%	98%	$0.92	361
Electric	Energy Efficiency	Multifamily	Refrigerator	Equipment	Refrigerator - RTF Tier 3	30%+ more efficient than Federal Standard 2014 Refrigerator	RTF Market Baseline Refrigerator	Existing	Per Refrigerator	111	17	$98.32	100%	100%	$0.09	11,503
Electric	Energy Efficiency	Multifamily	Refrigerator	Equipment	Refrigerator - RTF Tier 3	30%+ more efficient than Federal Standard 2014 Refrigerator	RTF Market Baseline Refrigerator	New	Per Refrigerator	111	17	$98.32	100%	100%	$0.09	6,015
Electric	Energy Efficiency	Multifamily	Ventilation And Circulation	Equipment	Motor - ECM	ECM Motor	Standard Motor	Existing	Per Motor (Ventilation and Circulation)	243	20	$172.26	50%	80%	$0.06	401

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 2.05	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	31	15	$681.20	30%	100%	$2.81	67
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	45	15	$505.75	30%	100%	$1.40	92
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	347	15	$6,307.25	5%	100%	$2.29	112
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	512	20	$4,874.83	15%	100%	$1.07	628
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 2.05	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	31	15	$681.20	30%	100%	$2.81	14
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	45	15	$505.75	30%	100%	$1.40	20
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	347	15	$6,307.25	5%	100%	$2.29	30
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	512	20	$4,874.83	15%	100%	$1.07	158
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 1.43	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	706	15	$1,069.54	30%	100%	$0.21	20,153
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	1026	20	$5,999.89	15%	100%	$0.67	20,816
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	1139	15	$1,605.29	30%	100%	$0.18	32,795
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	1428	15	$7,432.31	5%	100%	$0.66	7,603
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 1.43	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	706	15	$1,069.54	30%	100%	$0.21	7,417
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	1026	20	$5,999.89	15%	100%	$0.67	7,463
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	1139	15	$1,605.29	30%	100%	$0.18	12,069
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	1428	15	$7,432.31	5%	100%	$0.66	2,890
Electric	Energy Efficiency	Single Family	Air Purifier	Equipment	Air Purifier - ENERGY STAR	ENERGY STAR Air Purifier	Standard Air Purifier	Existing	Per Air Purifier	391	9	$10.00	100%	75%	-$0.02	3,668
Electric	Energy Efficiency	Single Family	Air Purifier	Equipment	Air Purifier - ENERGY STAR	ENERGY STAR Air Purifier	Standard Air Purifier	New	Per Air Purifier	391	9	$10.00	100%	75%	-$0.02	1,448
Electric	Energy Efficiency	Single Family	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	Existing	Per Cooking Oven	3	20	$282.71	100%	95%	$11.46	384
Electric	Energy Efficiency	Single Family	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	New	Per Cooking Oven	3	20	$282.71	100%	95%	$11.46	254
Electric	Energy Efficiency	Single Family	Cool Central	Equipment	Central Air Conditioner - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Central Air Conditioner SEER/EER 18/13 (Split System)	Federal Standard 2015 Central Air Conditioner SEER/EER 13/11.2 (Split System)	Existing	Per Central AC	171	15	$2,443.60	100%	95%	$1.81	12,376
Electric	Energy Efficiency	Single Family	Cool Central	Equipment	Central Air Conditioner - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Central Air Conditioner SEER/EER 18/13 (Split System)	Federal Standard 2015 Central Air Conditioner SEER/EER 13/11.2 (Split System)	New	Per Central AC	125	15	$1,966.80	100%	95%	$1.99	2,598
Electric	Energy Efficiency	Single Family	Cool Room	Equipment	Room AC - ENERGY STAR	ENERGY STAR Room AC - CEER 11.3 (8,000-13,999 Btuh)	Federal Standard 2014 Room AC - CEER 10.9 (8,000-	Existing	Per Room AC	2	9	$80.23	100%	49%	$7.47	12

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
							13,999 Btuh)									
Electric	Energy Efficiency	Single Family	Cool Room	Equipment	Room AC - ENERGY STAR	ENERGY STAR Room AC - CEER 11.3 (8,000-13,999 Btuh)	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	New	Per Room AC	1	9	$80.23	100%	49%	$12.88	1
Electric	Energy Efficiency	Single Family	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced - EFficiency Dryer - EF 4.10	Federal Standard 2015 Dryer - CEF 3.73	Existing	Per Dryer	56	11	$99.82	100%	100%	$0.25	22,745
Electric	Energy Efficiency	Single Family	Dryer	Equipment	Dryer - Heat Pump Dryer	Premium Efficiency - Heat Pump Dryer (0.23 kWh/kg Clothing)	Federal Standard 2015 Dryer - CEF 3.73	Existing	Per Dryer	375	16	$416.53	25%	100%	$0.12	64,795
Electric	Energy Efficiency	Single Family	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced - EFficiency Dryer - EF 4.10	Federal Standard 2015 Dryer - CEF 3.73	New	Per Dryer	56	11	$99.82	100%	100%	$0.25	8,491
Electric	Energy Efficiency	Single Family	Dryer	Equipment	Dryer - Heat Pump Dryer	Premium Efficiency - Heat Pump Dryer (0.23 kWh/kg Clothing)	Federal Standard 2015 Dryer - CEF 3.73	New	Per Dryer	375	16	$416.53	25%	100%	$0.12	22,621
Electric	Energy Efficiency	Single Family	Freezer	Equipment	Freezer - RTF Tier 3	30%+ More Efficient Than Federal Standard	RTF Market Standard Freezer	Existing	Per Freezer	119	20	$191.60	100%	100%	$0.17	2,229
Electric	Energy Efficiency	Single Family	Freezer	Equipment	Freezer - RTF Tier 3	30%+ More Efficient Than Federal Standard	RTF Market Standard Freezer	New	Per Freezer	119	20	$191.60	100%	100%	$0.17	5,703
Electric	Energy Efficiency	Single Family	Heat Pump	Equipment	Heat Pump - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Heat Pump - SEER/EER 18/12.5 and HSPF 9.6 (Split System)	RTF Single Family Market Standard Heat Pump - SEER/EER 13/11.2 and HSPF 8.5 (Split System)	Existing	Per Heat Pump	1015	20	$4,258.82	100%	100%	$0.43	7,671
Electric	Energy Efficiency	Single Family	Heat Pump	Equipment	Heat Pump - Ground Source	ENERGY STAR Ground Source Heat Pump - EER 17.1 and 3.6 COP (Split System)	RTF Single Family Market Standard Heat Pump - SEER/EER 13/11.2 and HSPF 8.5 (Split System)	Existing	Per Heat Pump	2048	20	$13,944.98	25%	100%	$0.73	5,161
Electric	Energy Efficiency	Single Family	Heat Pump	Equipment	Heat Pump - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Heat Pump - SEER/EER 18/12.5 and HSPF 9.6 (Split System)	RTF Single Family Market Standard Heat Pump - SEER/EER 13/11.2 and HSPF 8.5 (Split System)	New	Per Heat Pump	547	20	$3,220.09	100%	100%	$0.62	2,322
Electric	Energy Efficiency	Single Family	Heat Pump	Equipment	Heat Pump - Ground Source	ENERGY STAR Ground Source Heat Pump - EER 17.1 and 3.6 COP (Split System)	RTF Single Family Market Standard Heat Pump - SEER/EER 13/11.2 and HSPF 8.5 (Split System)	New	Per Heat Pump	1074	20	$10,543.78	25%	100%	$1.06	1,520
Electric	Energy Efficiency	Single Family	Lighting Exterior	Equipment	CFL	CFL	Incandescent - EISA Standard	Existing	Per Lamp (Exterior)	48	4	$1.12	92%	30%	-$0.01	6,757
Electric	Energy Efficiency	Single Family	Lighting Exterior	Equipment	LED	LED	Incandescent - EISA Standard	Existing	Per Lamp (Exterior)	59	12	$11.05	8%	95%	$0.01	2,402
Electric	Energy Efficiency	Single Family	Lighting Exterior	Equipment	CFL	CFL	Incandescent - EISA Standard	New	Per Lamp (Exterior)	48	4	$1.12	92%	30%	-$0.01	3,795
Electric	Energy Efficiency	Single Family	Lighting Exterior	Equipment	LED	LED	Incandescent - EISA Standard	New	Per Lamp (Exterior)	59	12	$11.05	8%	95%	$0.01	3,200
Electric	Energy Efficiency	Single Family	Lighting Interior Specialty	Equipment	CFL - Specialty	CFL - Specialty	Incandescent - Specialty	Existing	Per Lamp (Interior Specialty)	31	8	$1.28	45%	68%	-$0.01	13,780
Electric	Energy Efficiency	Single Family	Lighting Interior Specialty	Equipment	LED - Specialty	LED - Specialty	Incandescent - Specialty	Existing	Per Lamp (Interior Specialty)	36	12	$11.88	55%	98%	$0.03	179,290
Electric	Energy Efficiency	Single Family	Lighting Interior Specialty	Equipment	CFL - Specialty	CFL - Specialty	Incandescent - Specialty	New	Per Lamp (Interior Specialty)	31	8	$1.28	45%	68%	-$0.01	7,980
Electric	Energy Efficiency	Single Family	Lighting Interior Specialty	Equipment	LED - Specialty	LED - Specialty	Incandescent - Specialty	New	Per Lamp (Interior	36	12	$11.88	55%	98%	$0.03	66,154

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
									Specialty)							
Electric	Energy Efficiency	Single Family	Lighting Interior Standard	Equipment	LED	LED	Incandescent - EISA Standard	Existing	Per Lamp (Interior Standard)	22	12	$11.05	75%	95%	$0.06	73,551
Electric	Energy Efficiency	Single Family	Lighting Interior Standard	Equipment	LED	LED	Incandescent - EISA Standard	New	Per Lamp (Interior Standard)	22	12	$11.05	75%	95%	$0.06	17,034
Electric	Energy Efficiency	Single Family	Microwave	Equipment	Microwave - High Efficiency	High Efficiency Microwave	Federal Standard 2016 Microwave	Existing	Per Microwave Oven	10	20	$79.60	100%	98%	$0.92	2,020
Electric	Energy Efficiency	Single Family	Microwave	Equipment	Microwave - High Efficiency	High Efficiency Microwave	Federal Standard 2016 Microwave	New	Per Microwave Oven	10	20	$79.60	100%	98%	$0.92	1,296
Electric	Energy Efficiency	Single Family	Pool Pump	Equipment	Pool Pump - VSD	VSD Pool Pump	2 Speed Pool Pump	Existing	Per Pool Pump	251	10	$314.00	75%	98%	$0.18	16,550
Electric	Energy Efficiency	Single Family	Pool Pump	Equipment	Pool Pump - VSD	VSD Pool Pump	2 Speed Pool Pump	New	Per Pool Pump	251	10	$314.00	100%	98%	$0.18	1,321
Electric	Energy Efficiency	Single Family	Refrigerator	Equipment	Refrigerator - RTF Tier 3	30%+ more efficient than Federal Standard 2014 Refrigerator	RTF Market Baseline Refrigerator	Existing	Per Refrigerator	111	17	$98.32	100%	100%	$0.09	27,498
Electric	Energy Efficiency	Single Family	Refrigerator	Equipment	Refrigerator - RTF Tier 3	30%+ more efficient than Federal Standard 2014 Refrigerator	RTF Market Baseline Refrigerator	New	Per Refrigerator	111	17	$98.32	100%	100%	$0.09	22,077
Electric	Energy Efficiency	Single Family	Ventilation And Circulation	Equipment	Motor - ECM	ECM Motor	Standard Motor	Existing	Per Motor (Ventilation and Circulation)	433	20	$172.26	50%	80%	$0.02	6,239
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 2.05	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	50	15	$681.20	60%	100%	$1.71	273
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	74	15	$505.75	60%	100%	$0.85	1,123
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	569	15	$6,307.25	5%	100%	$1.39	686
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Heat Pump Water Heater - EF 1.99	Existing	Per Water Heater GT 55 Gal	1063	20	$4,874.83	15%	100%	$0.51	4,849
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 2.05	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	50	15	$681.20	60%	100%	$1.71	64
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	74	15	$505.75	60%	100%	$0.85	285
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	569	15	$6,307.25	5%	100%	$1.39	209
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Heat Pump Water Heater - EF 1.99	New	Per Water Heater GT 55 Gal	1063	20	$4,874.83	15%	100%	$0.51	1,404
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 1.43	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	1158	15	$1,069.54	60%	100%	$0.12	31,010
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	1870	15	$1,605.29	60%	100%	$0.11	151,661
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	2130	20	$5,999.89	15%	100%	$0.32	61,151
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.948	Existing	Per Water Heater LE 55 Gal	2343	15	$7,432.31	5%	100%	$0.40	17,618
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 1	RTF Tier 1 Heat Pump Water Heater - EF 1.43	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	1158	15	$1,069.54	60%	100%	$0.12	12,025

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - RTF Tier 2	RTF Tier 2 Heat Pump Water Heater - EF 2.08	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	1870	15	$1,605.29	60%	100%	$0.11	58,807
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	2130	20	$5,999.89	15%	100%	$0.32	23,088
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	CO2 Heat Pump Water Heater	CO2 Heat Pump Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Water Heater LE 55 Gal	2343	15	$7,432.31	5%	100%	$0.40	7,044
Electric	Energy Efficiency	Manufactured	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip with Occupancy Sensor	Standard Power Strip - Home Office Only	Existing	Per Power Strip - Home Office	67	5	$15.42	50%	95%	$0.04	2,407
Electric	Energy Efficiency	Manufactured	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip with Occupancy Sensor	Standard Power Strip - Home Office Only	New	Per Power Strip - Home Office	67	5	$15.42	50%	95%	$0.04	860
Electric	Energy Efficiency	Multifamily	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip with Occupancy Sensor	Standard Power Strip - Home Office Only	Existing	Per Power Strip - Home Office	67	5	$15.42	50%	95%	$0.04	7,741
Electric	Energy Efficiency	Multifamily	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip with Occupancy Sensor	Standard Power Strip - Home Office Only	New	Per Power Strip - Home Office	67	5	$15.42	50%	95%	$0.04	2,765
Electric	Energy Efficiency	Single Family	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip with Occupancy Sensor	Standard Power Strip - Home Office Only	Existing	Per Power Strip - Home Office	67	5	$15.42	50%	95%	$0.04	22,788
Electric	Energy Efficiency	Single Family	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip with Occupancy Sensor	Standard Power Strip - Home Office Only	New	Per Power Strip - Home Office	67	5	$15.42	50%	95%	$0.04	8,141
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	Existing	Per Home	319	20	$1,486.19	25%	95%	$0.49	1,477
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	New	Per Home	345	20	$1,486.19	25%	95%	$0.45	623
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	Existing	Per Home	220	20	$1,486.19	25%	95%	$0.73	433
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	New	Per Home	222	20	$1,486.19	25%	95%	$0.72	144
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	Existing	Per Home	97	20	$1,486.19	50%	95%	$1.68	1,047
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	New	Per Home	305	20	$1,486.19	50%	95%	$0.51	1,175
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	New	Per Home	138	20	$1,486.19	50%	95%	$1.17	588
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	158	45	$2,063.52	75%	1%	-$0.33	14
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	176	45	$2,063.52	75%	1%	-$1.13	13
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	3317	45	$2,063.52	75%	1%	$0.03	726
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	2412	45	$2,063.52	75%	1%	$0.06	201
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	3454	45	$2,063.52	75%	1%	$0.03	33
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	232	45	$2,042.27	85%	3%	-$0.03	1,011
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured	R-0 (Zero Insulation - Single Family and Manufactured	Existing	Per Home	38	45	$2,042.27	85%	3%	$0.17	44

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						Homes Only)	Homes Only)									
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	3187	45	$2,042.27	85%	3%	$0.02	3,222
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	2298	45	$2,042.27	85%	3%	$0.05	2,900
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	2210	45	$2,042.27	85%	3%	$0.05	3,311
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-8.0 (Existing Insulation - Manufactured Homes Only)	Existing	Per Home	83	45	$2,063.52	75%	35%	$1.03	250
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-8.0 (Existing Insulation - Manufactured Homes Only)	Existing	Per Home	92	45	$2,063.52	75%	35%	$0.19	235
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-8.0 (Existing Insulation - Manufactured Homes Only)	Existing	Per Home	1550	45	$2,063.52	75%	35%	$0.10	11,003
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-8.0 (Existing Insulation - Manufactured Homes Only)	Existing	Per Home	1075	45	$2,063.52	75%	35%	$0.17	2,654
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-8.0 (Existing Insulation - Manufactured Homes Only)	Existing	Per Home	1590	45	$2,063.52	75%	35%	$0.09	497
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-11.9 (Existing Insulation - Single Family Only)	Existing	Per Home	77	45	$2,042.27	85%	12%	$1.81	592
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-11.9 (Existing Insulation - Single Family Only)	Existing	Per Home	16	45	$2,042.27	85%	12%	$9.21	43
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-11.9 (Existing Insulation - Single Family Only)	Existing	Per Home	970	45	$2,042.27	85%	12%	$0.17	3,049
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-11.9 (Existing Insulation - Single Family Only)	Existing	Per Home	663	45	$2,042.27	85%	12%	$0.27	2,614
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-11.9 (Existing Insulation - Single Family Only)	Existing	Per Home	685	45	$2,042.27	85%	12%	$0.26	3,238
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	8	45	$1,261.04	40%	95%	$14.68	21
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	4	45	$1,261.04	60%	95%	$29.60	5
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	9	45	$1,261.04	40%	95%	$12.62	22
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	5	45	$1,261.04	60%	95%	$22.14	6

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	136	45	$1,261.04	40%	95%	$0.89	1,002
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	151	45	$1,261.04	60%	95%	$0.80	519
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	91	45	$1,261.04	40%	95%	$1.35	285
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	97	45	$1,261.04	60%	95%	$1.27	122
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	138	45	$1,261.04	40%	95%	$0.87	54
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	158	45	$1,261.04	60%	80%	$0.76	21
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	9	45	$1,248.05	75%	96%	$12.83	458
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	6	45	$1,073.90	90%	95%	$17.35	80
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	2	45	$1,248.05	75%	96%	$58.91	33
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	1	45	$1,073.90	90%	95%	$82.92	7
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	109	45	$1,248.05	75%	96%	$1.10	1,811
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	96	45	$1,073.90	90%	95%	$1.07	436
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	73	45	$1,248.05	75%	96%	$1.66	1,848
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	64	45	$1,073.90	90%	95%	$1.63	415
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	78	45	$1,248.05	75%	96%	$1.56	2,237
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	72	45	$1,073.90	90%	95%	$1.45	564
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-0 (Zero Insulation - Multi Family Only)	Existing	Per Home	32	25	$300.29	50%	2%	-$0.01	5
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-0 (Zero Insulation - Multi Family Only)	Existing	Per Home	13	25	$300.29	50%	2%	$0.68	2
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-0 (Zero Insulation - Multi Family Only)	Existing	Per Home	468	25	$300.29	50%	2%	$0.04	71

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-0 (Zero Insulation - Multi Family Only)	Existing	Per Home	297	25	$300.29	50%	2%	$0.08	5
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-0 (Zero Insulation - Multi Family Only)	Existing	Per Home	224	25	$300.29	50%	2%	$0.11	324
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-9.6 (Existing Insulation - Multi Family Only)	Existing	Per Home	7	25	$300.29	50%	2%	$3.53	1
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-9.6 (Existing Insulation - Multi Family Only)	Existing	Per Home	3	25	$300.29	50%	2%	$9.24	0
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-9.6 (Existing Insulation - Multi Family Only)	Existing	Per Home	100	25	$300.29	50%	2%	$0.30	11
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-9.6 (Existing Insulation - Multi Family Only)	Existing	Per Home	62	25	$300.29	50%	2%	$0.50	1
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-9.6 (Existing Insulation - Multi Family Only)	Existing	Per Home	48	25	$300.29	50%	2%	$0.66	60
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	Existing	Per Home	1	25	$37.55	15%	89%	$2.88	1
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	New	Per Home	0	25	$37.55	25%	80%	$3.65	0
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	Existing	Per Home	0	25	$37.55	15%	89%	$7.68	1
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	New	Per Home	0	25	$37.55	25%	80%	$10.77	0
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	Existing	Per Home	15	25	$37.55	15%	89%	$0.24	25
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	New	Per Home	41	25	$37.55	25%	80%	$0.07	36
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	Existing	Per Home	9	25	$37.55	15%	89%	$0.41	2
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	New	Per Home	32	25	$37.55	25%	80%	$0.10	3
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	Existing	Per Home	7	25	$37.55	15%	89%	$0.54	115
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	New	Per Home	19	25	$37.55	25%	80%	$0.19	159
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	1679	45	$1,662.28	25%	21%	$0.07	2,518
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	1029	45	$1,662.28	25%	21%	$0.14	534
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	2142	45	$1,662.28	25%	21%	$0.05	142
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	1131	25	$272.14	25%	11%	-$0.01	448
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	1025	25	$272.14	25%	11%	$0.00	50
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	515	25	$272.14	25%	11%	$0.03	1,937
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	1726	45	$1,645.16	25%	19%	$0.06	2,633
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	1016	45	$1,645.16	25%	19%	$0.13	1,931

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	1424	45	$1,645.16	25%	19%	$0.08	3,314
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Floor Insulation	R-30 (WA Code)	R-6.7 (Existing Insulation: Manufactured Homes)	Existing	Per Home	883	45	$1,662.28	25%	50%	$0.16	2,781
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Floor Insulation	R-30 (WA Code)	R-6.7 (Existing Insulation: Manufactured Homes)	Existing	Per Home	532	45	$1,662.28	25%	50%	$0.29	588
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Floor Insulation	R-30 (WA Code)	R-6.7 (Existing Insulation: Manufactured Homes)	Existing	Per Home	1128	45	$1,662.28	25%	50%	$0.12	157
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Floor Insulation	R-30 (WA Code)	R-5.2 (Existing Insulation: Multifamily)	Existing	Per Home	615	25	$272.14	25%	17%	$0.02	393
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Floor Insulation	R-30 (WA Code)	R-5.2 (Existing Insulation: Multifamily)	Existing	Per Home	546	25	$272.14	25%	17%	$0.03	43
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Floor Insulation	R-30 (WA Code)	R-5.2 (Existing Insulation: Multifamily)	Existing	Per Home	280	25	$272.14	25%	17%	$0.08	1,699
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Floor Insulation	R-30 (WA Code)	R-8.5 (Existing Insulation: Single Family)	Existing	Per Home	728	45	$1,645.16	25%	24%	$0.19	1,329
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Floor Insulation	R-30 (WA Code)	R-8.5 (Existing Insulation: Single Family)	Existing	Per Home	416	45	$1,645.16	25%	24%	$0.36	957
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Floor Insulation	R-30 (WA Code)	R-8.5 (Existing Insulation: Single Family)	Existing	Per Home	608	45	$1,645.16	25%	24%	$0.23	1,702
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	127	45	$272.27	25%	85%	$0.18	673
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	132	45	$272.27	75%	85%	$0.18	600
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	76	45	$272.27	25%	85%	$0.33	140
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	84	45	$272.27	75%	85%	$0.30	144
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	163	45	$272.27	25%	85%	$0.14	38
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	155	45	$272.27	75%	85%	$0.15	32
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	62	25	$44.57	25%	69%	$0.05	150
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	70	25	$44.57	75%	85%	$0.04	199
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	54	25	$44.57	25%	69%	$0.06	14
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	58	25	$44.57	75%	85%	$0.06	22
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	28	25	$44.57	25%	69%	$0.14	639
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	32	25	$44.57	75%	85%	$0.12	869
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	112	45	$269.47	25%	85%	$0.20	701
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	111	45	$231.87	75%	85%	$0.17	556
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	63	45	$269.47	25%	85%	$0.39	502
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	70	45	$231.87	75%	85%	$0.29	414

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	95	45	$269.47	25%	85%	$0.24	899
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	85	45	$231.87	75%	85%	$0.23	669
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	Existing	Per Home	16	45	$378.74	10%	90%	$2.28	11
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	New	Per Home	12	45	$378.74	10%	90%	$3.16	3
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	Existing	Per Home	19	45	$378.74	10%	90%	$1.99	12
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	New	Per Home	16	45	$378.74	10%	90%	$2.36	4
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	Existing	Per Home	27	45	$378.74	10%	90%	$1.38	19
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	New	Per Home	13	45	$378.74	10%	90%	$2.79	3
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	Existing	Per Home	19	25	$62.01	50%	90%	$0.36	120
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	New	Per Home	14	25	$62.01	75%	90%	$0.49	57
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	Existing	Per Home	7	25	$62.01	50%	90%	$1.00	53
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	New	Per Home	7	25	$62.01	75%	90%	$1.03	27
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	Existing	Per Home	24	25	$62.01	50%	90%	$0.24	15
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	New	Per Home	15	25	$62.01	75%	90%	$0.42	4
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	Existing	Per Home	36	45	$374.84	50%	90%	$1.01	1,151
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	New	Per Home	27	45	$322.54	75%	90%	$1.18	381
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	Existing	Per Home	3	45	$374.84	50%	90%	$10.89	39
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	New	Per Home	2	45	$322.54	75%	90%	$16.16	11
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	Existing	Per Home	34	45	$374.84	50%	90%	$1.05	542
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Radiant Barrier (Ceiling)	Install Radiant Barrier	No Radiant Barrier	New	Per Home	17	45	$322.54	75%	90%	$1.80	102
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Slab Insulation	R-10 with R-5 Thermal Break (Above WA Code)	R-10 (WA Code)	New	Per Home	108	45	$1,891.56	75%	75%	$1.71	358
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Slab Insulation	R-10 with R-5 Thermal Break (Above WA Code)	R-10 (WA Code)	New	Per Home	61	45	$1,891.56	75%	75%	$3.06	87
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Slab Insulation	R-10 with R-5 Thermal Break (Above WA Code)	R-10 (WA Code)	New	Per Home	111	45	$1,891.56	75%	75%	$1.67	20
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Slab Insulation	R-10 with R-5 Thermal Break (Above WA Code)	R-10 (WA Code)	New	Per Home	151	45	$1,610.86	75%	75%	$1.02	535
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Slab Insulation	R-10 with R-5 Thermal Break (Above WA Code)	R-10 (WA Code)	New	Per Home	88	45	$1,610.86	75%	75%	$1.78	431
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Slab Insulation	R-10 with R-5 Thermal Break (Above WA Code)	R-10 (WA Code)	New	Per Home	117	45	$1,610.86	75%	75%	$1.33	723
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	47	45	$3,273.26	60%	15%	$2.25	34

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	51	45	$3,273.26	60%	15%	-$0.39	45
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	2836	45	$3,273.26	60%	15%	$0.08	7,024
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	2024	45	$3,273.26	60%	15%	$0.14	1,739
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	3001	45	$3,273.26	60%	15%	$0.08	327
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	1277	25	$856.28	60%	9%	$0.04	975
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	1229	25	$856.28	60%	9%	$0.05	103
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	582	25	$856.28	60%	9%	$0.13	4,224
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	75	45	$4,005.46	60%	23%	$2.01	744
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	12	45	$4,005.46	60%	23%	$13.49	43
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	3670	45	$4,005.46	60%	23%	$0.07	16,498
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	2523	45	$4,005.46	60%	23%	$0.12	14,167
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	2528	45	$4,005.46	60%	23%	$0.12	17,274
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	388	45	$1,504.31	75%	95%	$0.36	1,937
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	261	45	$1,504.31	75%	95%	$0.55	491
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	417	45	$1,504.31	75%	95%	$0.33	96
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	0	45	$1,840.81	75%	95%	$5,269.62	0
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	458	45	$1,840.81	75%	95%	$0.36	2,429
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	313	45	$1,840.81	75%	95%	$0.55	2,033
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	334	45	$1,840.81	75%	95%	$0.51	2,766

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Wall Insulation 2x6	R-21 (Above WA Code - Multi Family Only)	R-13 + R-6 sheathing (WA Code - Multi Family Only)	New	Per Home	0	25	-$280.58	75%	95%	-$84.58	1
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Wall Insulation 2x6	R-21 (Above WA Code - Multi Family Only)	R-13 + R-6 sheathing (WA Code - Multi Family Only)	New	Per Home	0	25	-$280.58	75%	95%	-$174.19	1
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	Existing	Per Home	170	10	$731.89	85%	35%	$0.67	647
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	New	Per Home	120	10	$731.89	85%	35%	$0.94	169
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	Existing	Per Home	189	10	$731.89	85%	35%	$0.60	559
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	New	Per Home	158	10	$731.89	85%	35%	$0.72	166
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	Existing	Per Home	38	10	$731.89	85%	35%	$2.96	138
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	New	Per Home	16	10	$731.89	85%	35%	$7.30	21
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	Existing	Per Home	155	10	$302.69	85%	50%	$0.30	941
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	New	Per Home	111	10	$302.69	85%	50%	$0.42	290
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	Existing	Per Home	57	10	$302.69	85%	50%	$0.82	415
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	New	Per Home	54	10	$302.69	85%	50%	$0.87	141
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	Existing	Per Home	21	10	$302.69	85%	50%	$2.23	16
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	New	Per Home	10	10	$302.69	85%	50%	$4.50	3
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	Existing	Per Home	335	10	$810.86	85%	50%	$0.37	22,207
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	New	Per Home	242	10	$810.86	85%	50%	$0.52	5,267
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	Existing	Per Home	43	10	$810.86	85%	50%	$2.97	724
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	New	Per Home	28	10	$810.86	85%	50%	$4.56	168
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	Existing	Per Home	78	10	$810.86	85%	50%	$1.58	1,694
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Ceiling Fan	Ceiling Fan (no lighting kit)	No Ceiling Fan	New	Per Home	44	10	$810.86	85%	50%	$2.82	326
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	Existing	Per Clothes Washer	85	14	$175.48	100%	99%	$0.16	31
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	New	Per Clothes Washer	85	14	$175.48	100%	100%	$0.16	10
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	Existing	Per Clothes Washer	85	14	$175.48	100%	99%	$0.16	364
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	New	Per Clothes Washer	85	14	$175.48	100%	100%	$0.16	62

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	Existing	Per Clothes Washer	85	14	$142.41	15%	100%	$0.13	7
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	New	Per Clothes Washer	85	14	$142.41	15%	100%	$0.13	2
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	Existing	Per Clothes Washer	85	14	$142.41	15%	100%	$0.13	144
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	New	Per Clothes Washer	85	14	$142.41	15%	100%	$0.13	31
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	Existing	Per Clothes Washer	85	14	$190.04	100%	100%	$0.18	240
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	New	Per Clothes Washer	85	14	$190.04	100%	100%	$0.18	74
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	Existing	Per Clothes Washer	85	14	$190.04	100%	100%	$0.18	1,692
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Electric DHW & Dryer)	New	Per Clothes Washer	85	14	$190.04	100%	100%	$0.18	283
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	Existing	Per Clothes Washer	79	14	$157.85	100%	100%	$0.16	131
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	New	Per Clothes Washer	79	14	$157.85	100%	100%	$0.16	93
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	Existing	Per Clothes Washer	79	14	$157.85	100%	100%	$0.16	1,846
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	New	Per Clothes Washer	79	14	$157.85	100%	100%	$0.16	600
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	Existing	Per Clothes Washer	79	14	$128.10	15%	100%	$0.13	32
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	New	Per Clothes Washer	79	14	$128.10	15%	100%	$0.13	23

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	Existing	Per Clothes Washer	79	14	$128.10	15%	100%	$0.13	869
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	New	Per Clothes Washer	79	14	$128.10	15%	100%	$0.13	299
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	Existing	Per Clothes Washer	79	14	$170.95	100%	100%	$0.18	1,014
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	New	Per Clothes Washer	79	14	$170.95	100%	100%	$0.18	719
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	Existing	Per Clothes Washer	79	14	$170.95	100%	100%	$0.18	8,488
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Electric DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Electric DHW & Dryer)	New	Per Clothes Washer	79	14	$170.95	100%	100%	$0.18	2,759
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	62	15	$25.80	95%	46%	$0.04	51
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	62	15	$25.80	95%	46%	$0.04	723
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	62	15	$25.80	95%	66%	$0.04	130
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	62	15	$25.80	95%	66%	$0.04	3,477
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	62	15	$25.80	95%	72%	$0.04	532
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	62	15	$25.80	95%	72%	$0.04	4,418
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	26
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	15
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	359
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	111
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	47
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	24
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	1,268
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	407
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	Existing	Per Tank Wrap per Gallon	2	10	$63.10	95%	20%	$6.37	167

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
									DWH Storage							
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	93
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	1,381
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-10)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	2	10	$63.10	95%	20%	$6.37	447
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	4	15	$2.25	100%	50%	-$0.01	3
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	4	15	$2.25	100%	50%	-$0.01	2
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	4	15	$2.25	100%	50%	-$0.01	43
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	4	15	$2.25	100%	50%	-$0.01	14
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	4	15	$3.18	100%	50%	-$0.01	9
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	4	15	$3.18	100%	50%	-$0.01	6
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	4	15	$3.18	100%	50%	-$0.01	233
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	4	15	$3.18	100%	50%	-$0.01	79
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	4	15	$2.95	100%	50%	-$0.01	28
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	4	15	$2.95	100%	50%	-$0.01	20
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	4	15	$2.95	100%	50%	-$0.01	237
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	4	15	$2.95	100%	50%	-$0.01	76
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	Existing	Per Door	54	20	$29.11	15%	95%	$0.03	218
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	New	Per Door	52	20	$29.11	15%	95%	$0.03	80

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	Existing	Per Door	36	20	$29.11	15%	95%	$0.07	51
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	New	Per Door	34	20	$29.11	15%	95%	$0.07	21
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	Existing	Per Door	57	20	$29.11	15%	95%	$0.03	10
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	New	Per Door	56	20	$29.11	15%	95%	$0.03	4
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	Existing	Per Door	138	20	$71.91	15%	100%	$0.02	679
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	New	Per Door	128	20	$71.91	15%	95%	$0.02	184
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	Existing	Per Door	90	20	$71.91	15%	100%	$0.05	551
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	New	Per Door	86	20	$71.91	15%	95%	$0.06	151
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	Existing	Per Door	97	20	$71.91	15%	100%	$0.04	720
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	New	Per Door	93	20	$71.91	15%	95%	$0.05	192
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Doors	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	R-2.5 (Standard non-thermal wood door) (Below WA Code - Single Family and Manufactured Homes Only)	Existing	Per Door	107	20	$49.32	85%	75%	$0.02	1,986
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Doors	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	R-2.5 (Standard non-thermal wood door) (Below WA Code - Single Family and Manufactured Homes Only)	Existing	Per Door	72	20	$49.32	85%	75%	$0.05	450

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Doors	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	R-2.5 (Standard non-thermal wood door) (Below WA Code - Single Family and Manufactured Homes Only)	Existing	Per Door	112	20	$49.32	85%	75%	$0.02	90
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Doors	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	R-2.5 (Standard non-thermal wood door) (Below WA Code - Single Family and Manufactured Homes Only)	Existing	Per Door	271	20	$121.82	85%	77%	$0.01	6,121
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Doors	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	R-2.5 (Standard non-thermal wood door) (Below WA Code - Single Family and Manufactured Homes Only)	Existing	Per Door	174	20	$121.82	85%	77%	$0.04	4,769
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Doors	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	R-2.5 (Standard non-thermal wood door) (Below WA Code - Single Family and Manufactured Homes Only)	Existing	Per Door	188	20	$121.82	85%	77%	$0.03	6,299
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	Existing	Per Door	332	20	$78.43	4%	100%	-$0.01	183
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	299	20	$78.43	4%	80%	$0.00	47
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	Existing	Per Door	304	20	$78.43	4%	100%	$0.00	21
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	269	20	$78.43	4%	80%	$0.00	6
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	Existing	Per Door	151	20	$78.43	4%	100%	$0.03	791
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	138	20	$78.43	4%	80%	$0.03	207
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	Existing	Per Door	222	20	$49.32	21%	18%	-$0.01	103
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	200	20	$49.32	21%	60%	$0.00	111
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	Existing	Per Door	202	20	$49.32	21%	18%	$0.00	12
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	180	20	$49.32	21%	60%	$0.00	13
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-	Existing	Per Door	101	20	$49.32	21%	18%	$0.02	449

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						Code - Multi-Family Only)	Family Only)									
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	92	20	$49.32	21%	60%	$0.03	483
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	47	5	$30.22	13%	50%	$0.13	59
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	27	5	$30.22	13%	50%	$0.26	14
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	69	5	$30.22	13%	50%	$0.08	5
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	56	5	$30.22	13%	18%	$0.10	14
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	53	5	$30.22	13%	18%	$0.11	2
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	26	5	$30.22	13%	18%	$0.26	60
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	288	5	$74.65	13%	77%	$0.03	852
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	219	5	$74.65	13%	77%	$0.05	823
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	210	5	$74.65	13%	77%	$0.05	947
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	Existing	Per Home	308	40	$463.82	29%	90%	$0.14	152
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	308	40	$463.82	59%	90%	$0.14	127
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	Existing	Per Home	308	40	$463.82	29%	90%	$0.14	2,134
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	308	40	$463.82	59%	90%	$0.14	864
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	366	40	$463.82	59%	90%	$0.11	258
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	366	40	$463.82	59%	90%	$0.11	3,824
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	Existing	Per Home	375	40	$463.82	29%	90%	$0.11	1,230
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	375	40	$463.82	59%	90%	$0.11	1,042
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	Existing	Per Home	375	40	$463.82	29%	90%	$0.11	10,210
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	375	40	$463.82	59%	90%	$0.11	4,348
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Duct Location	Conditioned Space Design - Duct Loss Is Not A Concern	Ducts in Unconditioned Space (Duct loss)	New	Per Home	21	30	$278.00	75%	10%	-$0.83	7
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Duct Location	Conditioned Space Design - Duct Loss Is Not A Concern	Ducts in Unconditioned Space (Duct loss)	New	Per Home	599	30	$278.00	75%	10%	$0.02	497
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Duct Location	Conditioned Space Design - Duct Loss Is Not A Concern	Ducts in Unconditioned Space (Duct loss)	New	Per Home	646	30	$278.00	75%	10%	$0.02	215
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Duct Location	Conditioned Space Design - Duct Loss Is Not A Concern	Ducts in Unconditioned Space (Duct loss)	New	Per Home	30	30	$278.00	75%	10%	-$0.25	114

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Duct Location	Conditioned Space Design - Duct Loss Is Not A Concern	Ducts in Unconditioned Space (Duct loss)	New	Per Home	492	30	$278.00	75%	10%	$0.02	467
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Duct Location	Conditioned Space Design - Duct Loss Is Not A Concern	Ducts in Unconditioned Space (Duct loss)	New	Per Home	486	30	$278.00	75%	10%	$0.02	627
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Combined Duct Sealing and Insulation	Duct Sealing and R-8 Duct Insualtion	No Duct Sealing and Baseline Duct Insulation	Existing	Per Home	31	20	$375.00	50%	60%	-$1.12	113
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Combined Duct Sealing and Insulation	Duct Sealing and R-8 Duct Insualtion	No Duct Sealing and Baseline Duct Insulation	Existing	Per Home	981	20	$375.00	50%	60%	$0.01	8,905
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Combined Duct Sealing and Insulation	Duct Sealing and R-8 Duct Insualtion	No Duct Sealing and Baseline Duct Insulation	Existing	Per Home	906	20	$375.00	50%	60%	$0.02	3,146
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Combined Duct Sealing and Insulation	Duct Sealing and R-8 Duct Insualtion	No Duct Sealing and Baseline Duct Insulation	Existing	Per Home	36	20	$538.25	50%	60%	-$0.03	1,619
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Combined Duct Sealing and Insulation	Duct Sealing and R-8 Duct Insualtion	No Duct Sealing and Baseline Duct Insulation	Existing	Per Home	985	20	$538.25	50%	60%	$0.02	9,981
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Combined Duct Sealing and Insulation	Duct Sealing and R-8 Duct Insualtion	No Duct Sealing and Baseline Duct Insulation	Existing	Per Home	873	20	$538.25	50%	60%	$0.03	11,242
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	Existing	Per Home	35	30	$128.42	5%	95%	-$1.92	20
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	New	Per Home	17	30	$128.42	15%	95%	-$1.36	11
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	Existing	Per Home	1038	30	$128.42	5%	95%	-$0.02	1,554
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	New	Per Home	466	30	$128.42	15%	95%	$0.00	747
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	Existing	Per Home	942	30	$128.42	5%	95%	-$0.01	544
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	New	Per Home	498	30	$128.42	15%	95%	$0.00	322
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	Existing	Per Home	43	30	$128.42	5%	95%	$0.13	301
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	New	Per Home	22	30	$128.42	15%	95%	-$0.28	160
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	Existing	Per Home	224	30	$128.42	5%	95%	$0.02	366
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not	Standard ducts with 13 SEER HVAC	New	Per Home	267	30	$128.42	15%	95%	$0.01	485

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						require mastic or drawbands (5 per unit)										
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	Standard ducts with 13 SEER HVAC	New	Per Home	261	30	$128.42	15%	95%	$0.02	645
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	71	9	$0.00	100%	95%	-$0.26	232
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	31	9	$0.00	100%	95%	-$0.35	42
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	70	9	$0.00	100%	95%	-$0.27	3,229
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	65	9	$0.00	100%	95%	-$0.17	563
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	93	9	$0.00	100%	95%	-$0.21	465
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	41	9	$0.00	100%	95%	-$0.35	110
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	92	9	$0.00	100%	95%	-$0.21	12,491
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	85	9	$0.00	100%	95%	-$0.17	2,998
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	61	9	$0.00	100%	95%	-$0.36	1,971
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	27	9	$0.00	100%	95%	-$0.35	257
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	61	9	$0.00	100%	95%	-$0.36	16,320
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	56	9	$0.00	100%	95%	-$0.17	2,054
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	34	9	$12.35	100%	15%	-$0.20	17
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	33	9	$12.35	100%	15%	-$0.21	240
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	44	9	$9.49	100%	15%	-$0.17	35
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	43	9	$9.49	100%	15%	-$0.17	928
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	29	9	$17.11	100%	15%	-$0.26	146
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	28	9	$17.11	100%	15%	-$0.26	1,213
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	94	9	$0.00	100%	65%	-$0.23	122
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	41	9	$0.00	100%	65%	-$0.51	38
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator -	93	9	$0.00	100%	65%	-$0.24	1,706

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
									Kitchen							
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	86	9	$0.00	100%	65%	-$0.25	507
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	94	9	$0.00	100%	65%	-$0.23	246
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	41	9	$0.00	100%	65%	-$0.51	76
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	93	9	$0.00	100%	65%	-$0.24	6,598
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	86	9	$0.00	100%	65%	-$0.25	2,076
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	112	9	$0.00	100%	65%	-$0.23	1,041
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	49	9	$0.00	100%	65%	-$0.51	321
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	110	9	$0.00	100%	65%	-$0.24	8,621
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	103	9	$0.00	100%	65%	-$0.25	2,563
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	107	9	$7.24	100%	15%	-$0.22	32
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	106	9	$7.24	100%	15%	-$0.23	450
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	107	9	$7.24	100%	15%	-$0.22	65
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	106	9	$7.24	100%	15%	-$0.23	1,740
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	128	9	$7.24	100%	15%	-$0.23	275
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	126	9	$7.24	100%	15%	-$0.23	2,274
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Conversion Room AC to Ductless Heat Pump	Ductless Heat Pump	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	Existing	Per Home	123	15	$3,470.41	18%	95%	$3.58	146
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Conversion Room AC to Ductless Heat Pump	Ductless Heat Pump	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	New	Per Home	104	15	$3,470.41	18%	95%	$4.23	2
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Conversion Room AC to Ductless Heat Pump	Ductless Heat Pump	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	Existing	Per Home	45	15	$3,470.41	10%	95%	$9.79	53
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Conversion Room AC to Ductless Heat Pump	Ductless Heat Pump	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	New	Per Home	43	15	$3,470.41	10%	95%	$10.14	1
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Conversion Room AC to Ductless Heat Pump	Ductless Heat Pump	Federal Standard 2014 Room AC - CEER 10.9 (8,000-13,999 Btuh)	Existing	Per Home	22	15	$3,470.41	8%	95%	$19.67	38
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Conversion Room AC to Ductless Heat Pump	Ductless Heat Pump	Federal Standard 2014 Room AC - CEER 10.9 (8,000-	New	Per Home	13	15	$3,470.41	8%	95%	$33.87	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
							13,999 Btuh)									
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Conversion Baseboard Heating to Ductless Heat Pump	Ductless Heat Pump	Baseboard Heating HSPF = 1	Existing	Per Home	2675	15	$3,470.41	15%	62%	$0.14	263
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Conversion Baseboard Heating to Ductless Heat Pump	Ductless Heat Pump	Baseboard Heating HSPF = 1	New	Per Home	1365	15	$3,470.41	15%	95%	$0.29	3
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Conversion Baseboard Heating to Ductless Heat Pump	Ductless Heat Pump	Baseboard Heating HSPF = 1	Existing	Per Home	708	15	$3,470.41	66%	85%	$0.59	47,418
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Conversion Baseboard Heating to Ductless Heat Pump	Ductless Heat Pump	Baseboard Heating HSPF = 1	New	Per Home	430	15	$3,470.41	66%	95%	$0.99	532
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Conversion Baseboard Heating to Ductless Heat Pump	Ductless Heat Pump	Baseboard Heating HSPF = 1	Existing	Per Home	2141	15	$3,470.41	27%	91%	$0.17	23,448
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Conversion Baseboard Heating to Ductless Heat Pump	Ductless Heat Pump	Baseboard Heating HSPF = 1	New	Per Home	1020	15	$3,470.41	27%	95%	$0.39	163
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Conversion Electric Furnace to Air Source Heat Pump	Air Source Heat Pump SEER 14 HSPF 8.2	Electric Furnace HSPF = 1	Existing	Per Home	2511	20	$5,726.35	65%	93%	$0.23	37,222
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Conversion Electric Furnace to Air Source Heat Pump	Air Source Heat Pump SEER 14 HSPF 8.2	Electric Furnace HSPF = 1	New	Per Home	962	20	$5,726.35	65%	95%	$0.64	203
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Conversion Electric Furnace to Air Source Heat Pump	Air Source Heat Pump SEER 14 HSPF 8.2	Electric Furnace HSPF = 1	Existing	Per Home	2365	20	$5,726.35	35%	94%	$0.24	9,744
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Conversion Electric Furnace to Air Source Heat Pump	Air Source Heat Pump SEER 14 HSPF 8.2	Electric Furnace HSPF = 1	New	Per Home	1314	20	$5,726.35	35%	95%	$0.45	89
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Conversion Electric Furnace to Air Source Heat Pump	Air Source Heat Pump SEER 14 HSPF 8.2	Electric Furnace HSPF = 1	Existing	Per Home	3013	20	$5,726.35	74%	95%	$0.17	62,733
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Conversion Electric Furnace to Air Source Heat Pump	Air Source Heat Pump SEER 14 HSPF 8.2	Electric Furnace HSPF = 1	New	Per Home	1092	20	$5,726.35	74%	95%	$0.55	285
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- Without PTCS Commissioning, Controls, & Sizing	Existing	Per PTCS	27	20	$430.31	95%	95%	$1.80	205
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- Without PTCS Commissioning, Controls, & Sizing	Existing	Per PTCS	666	20	$430.31	95%	92%	$0.05	6,335
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- Without PTCS Commissioning, Controls, & Sizing	Existing	Per PTCS	32	20	$430.31	95%	95%	$1.51	376
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- Without PTCS Commissioning, Controls, & Sizing	Existing	Per PTCS	1012	20	$430.31	95%	94%	$0.02	1,133
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- Without PTCS Commissioning, Controls, & Sizing	Existing	Per PTCS	94	20	$430.31	95%	95%	$0.50	11,638
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- Without PTCS Commissioning, Controls, & Sizing	Existing	Per PTCS	1152	20	$430.31	95%	95%	$0.01	53,876
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- Without PTCS Commissioning, Controls, & Sizing	New	Per PTCS	20	20	$430.31	95%	95%	$2.43	60
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- Without PTCS Commissioning, Controls, & Sizing	New	Per PTCS	334	20	$430.31	95%	95%	$0.12	1,095
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Central AC- PTCS Commissioning,	Central AC- PTCS Commissioning,	Central AC- Without PTCS Commissioning,	New	Per PTCS	28	20	$430.31	95%	95%	$1.73	109

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
					Controls, & Sizing	Controls, & Sizing	Controls, & Sizing									
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- Without PTCS Commissioning, Controls, & Sizing	New	Per PTCS	522	20	$430.31	95%	95%	$0.06	267
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- PTCS Commissioning, Controls, & Sizing	Central AC- Without PTCS Commissioning, Controls, & Sizing	New	Per PTCS	63	20	$430.31	95%	95%	$0.75	2,497
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- PTCS Commissioning, Controls, & Sizing	Heat Pump- Without PTCS Commissioning, Controls, & Sizing	New	Per PTCS	596	20	$430.31	95%	95%	$0.05	9,162
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	Existing	Per A/C Tune-up	11	5	$150.00	95%	75%	$3.49	55
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	New	Per A/C Tune-up	11	5	$150.00	95%	75%	$3.49	22
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	Existing	Per Heat Pump Tune-up	183	5	$150.00	95%	75%	$0.18	1,104
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	New	Per Heat Pump Tune-up	183	5	$150.00	95%	75%	$0.18	367
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	Existing	Per A/C Tune-up	11	5	$150.00	95%	75%	$3.49	74
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	New	Per A/C Tune-up	11	5	$150.00	95%	75%	$3.49	29
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	Existing	Per Heat Pump Tune-up	183	5	$150.00	95%	75%	$0.18	176
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	New	Per Heat Pump Tune-up	183	5	$150.00	95%	75%	$0.18	55
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	Existing	Per A/C Tune-up	11	5	$150.00	95%	75%	$3.49	501
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	New	Per A/C Tune-up	11	5	$150.00	95%	75%	$3.49	147
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	Existing	Per Heat Pump Tune-up	183	5	$150.00	95%	75%	$0.17	4,825
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Check Me! O&M Tune-up	Tune-up/Maintenance	No Tune-up Maintenance	New	Per Heat Pump Tune-up	183	5	$150.00	95%	75%	$0.17	1,308
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	132	11	$2,176.20	64%	49%	$2.45	798
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	72	11	$2,176.20	64%	49%	$4.54	184
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	195	11	$2,176.20	64%	49%	$1.65	63
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	649	11	$1,499.40	64%	50%	$0.31	2,204
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	635	11	$1,499.40	64%	50%	$0.33	283
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	303	11	$1,499.40	64%	50%	$0.71	9,544
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	345	11	$3,400.20	64%	50%	$1.44	2,495
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	262	11	$3,400.20	64%	50%	$1.92	2,885

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
					Door test											
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	252	11	$3,400.20	64%	50%	$1.99	3,172
Electric	Energy Efficiency	Manufactured	Lighting Interior Standard	Retrofit	Occupancy Sensors	Wall-Switch Occupancy Sensors	No Occupancy Sensor	Existing	Per Occupancy Sensor	8	8	$319.00	20%	95%	$6.87	611
Electric	Energy Efficiency	Manufactured	Lighting Interior Standard	Retrofit	Occupancy Sensors	Wall-Switch Occupancy Sensors	No Occupancy Sensor	New	Per Occupancy Sensor	8	8	$319.00	20%	95%	$6.87	218
Electric	Energy Efficiency	Multifamily	Lighting Interior Standard	Retrofit	Occupancy Sensors	Wall-Switch Occupancy Sensors	No Occupancy Sensor	Existing	Per Occupancy Sensor	8	8	$239.25	20%	95%	$5.45	1,453
Electric	Energy Efficiency	Multifamily	Lighting Interior Standard	Retrofit	Occupancy Sensors	Wall-Switch Occupancy Sensors	No Occupancy Sensor	New	Per Occupancy Sensor	8	8	$239.25	20%	95%	$5.45	518
Electric	Energy Efficiency	Single Family	Lighting Interior Standard	Retrofit	Occupancy Sensors	Wall-Switch Occupancy Sensors	No Occupancy Sensor	Existing	Per Occupancy Sensor	9	8	$398.75	20%	95%	$7.69	8,020
Electric	Energy Efficiency	Single Family	Lighting Interior Standard	Retrofit	Occupancy Sensors	Wall-Switch Occupancy Sensors	No Occupancy Sensor	New	Per Occupancy Sensor	9	8	$398.75	20%	95%	$7.69	2,864
Electric	Energy Efficiency	Manufactured	Lighting Exterior	Retrofit	Daylighting Controls (Photocell) & Occupancy Sensors - Outdoors	Install Photocell & Occupancy Sensor	No Lighting Controls	Existing	Per Photocell & Occupancy Sensor	32	8	$416.63	5%	95%	$2.31	34
Electric	Energy Efficiency	Manufactured	Lighting Exterior	Retrofit	Daylighting Controls (Photocell) & Occupancy Sensors - Outdoors	Install Photocell & Occupancy Sensor	No Lighting Controls	New	Per Photocell & Occupancy Sensor	32	8	$416.63	5%	95%	$2.31	12
Electric	Energy Efficiency	Multifamily	Lighting Exterior	Retrofit	Daylighting Controls (Photocell) & Occupancy Sensors - Outdoors	Install Photocell & Occupancy Sensor	No Lighting Controls	Existing	Per Photocell & Occupancy Sensor	32	8	$138.88	5%	96%	$0.76	97
Electric	Energy Efficiency	Multifamily	Lighting Exterior	Retrofit	Daylighting Controls (Photocell) & Occupancy Sensors - Outdoors	Install Photocell & Occupancy Sensor	No Lighting Controls	New	Per Photocell & Occupancy Sensor	32	8	$138.88	5%	95%	$0.76	35
Electric	Energy Efficiency	Single Family	Lighting Exterior	Retrofit	Daylighting Controls (Photocell) & Occupancy Sensors - Outdoors	Install Photocell & Occupancy Sensor	No Lighting Controls	Existing	Per Photocell & Occupancy Sensor	33	8	$555.50	5%	45%	$3.06	724
Electric	Energy Efficiency	Single Family	Lighting Exterior	Retrofit	Daylighting Controls (Photocell) & Occupancy Sensors - Outdoors	Install Photocell & Occupancy Sensor	No Lighting Controls	New	Per Photocell & Occupancy Sensor	33	8	$555.50	5%	95%	$3.06	562
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	11	45	$795.60	75%	75%	$7.16	18
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	15	45	$795.60	75%	75%	$5.28	22
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	12	45	$795.60	75%	75%	$6.27	41
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	80	45	$795.60	75%	75%	$0.96	122
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	14	45	$795.60	75%	75%	$5.43	2
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	12	25	$795.60	40%	75%	$6.95	14
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	6	25	$795.60	40%	75%	$14.46	8
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	10	25	$795.60	40%	75%	$8.96	10

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	88	25	$795.60	40%	75%	$0.97	11
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	5	25	$795.60	40%	75%	$19.52	43
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	25	45	$795.60	75%	75%	$3.12	275
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	2	45	$795.60	75%	75%	$42.77	8
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	16	45	$795.60	75%	75%	$4.99	54
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	105	45	$795.60	75%	75%	$0.72	573
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	11	45	$795.60	75%	75%	$7.36	63
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Construction - ICF	Concrete Framing	Standard Wood Framing	New	Per Home	0	25	$2,131.41	25%	95%	$943.81	0
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Construction - ICF	Concrete Framing	Standard Wood Framing	New	Per Home	1	45	$4,833.41	25%	95%	$710.00	3
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	7	45	$920.43	25%	95%	-$0.15	7
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	9	45	$920.43	25%	95%	-$6.04	8
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	1202	45	$920.43	25%	95%	$0.05	3,119
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	800	45	$920.43	25%	95%	$0.09	828
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	1285	45	$920.43	25%	95%	$0.04	137
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	297	25	$634.18	25%	95%	$0.20	330
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	260	25	$634.18	25%	95%	$0.24	35
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	137	25	$634.18	25%	95%	$0.48	1,450
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	1	45	$1,438.14	25%	95%	$113.53	1
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	820	45	$1,438.14	25%	95%	$0.14	1,757
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	560	45	$1,438.14	25%	95%	$0.22	1,476
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	599	45	$1,438.14	25%	95%	$0.20	2,010
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	483	45	$604.50	85%	95%	$0.10	3,956
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	301	45	$604.50	85%	95%	$0.18	824
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	484	45	$604.50	85%	95%	$0.10	164
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	343	25	$416.50	85%	95%	$0.10	1,422
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	282	25	$416.50	85%	95%	$0.13	139

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	155	25	$416.50	85%	95%	$0.26	6,122
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	1234	45	$944.50	85%	95%	$0.04	12,522
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	859	45	$944.50	85%	95%	$0.07	10,284
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	911	45	$944.50	85%	95%	$0.06	13,496
Electric	Energy Efficiency	Manufactured	Plug Load Other	Retrofit	1-Watt Standby Power	1W or less standby power use for small appliances	Standard plug load appliance	Existing	Per Device - 1W Standby Power	1	45	$150.00	50%	50%	$10.62	105
Electric	Energy Efficiency	Manufactured	Plug Load Other	Retrofit	1-Watt Standby Power	1W or less standby power use for small appliances	Standard plug load appliance	New	Per Device - 1W Standby Power	1	45	$150.00	50%	50%	$10.62	37
Electric	Energy Efficiency	Multifamily	Plug Load Other	Retrofit	1-Watt Standby Power	1W or less standby power use for small appliances	Standard plug load appliance	Existing	Per Device - 1W Standby Power	1	45	$150.00	50%	50%	$10.62	299
Electric	Energy Efficiency	Multifamily	Plug Load Other	Retrofit	1-Watt Standby Power	1W or less standby power use for small appliances	Standard plug load appliance	New	Per Device - 1W Standby Power	1	45	$150.00	50%	50%	$10.62	107
Electric	Energy Efficiency	Single Family	Plug Load Other	Retrofit	1-Watt Standby Power	1W or less standby power use for small appliances	Standard plug load appliance	Existing	Per Device - 1W Standby Power	1	45	$240.00	50%	50%	$17.00	1,592
Electric	Energy Efficiency	Single Family	Plug Load Other	Retrofit	1-Watt Standby Power	1W or less standby power use for small appliances	Standard plug load appliance	New	Per Device - 1W Standby Power	1	45	$240.00	50%	50%	$17.00	569
Electric	Energy Efficiency	Manufactured	Plug Load Other	Retrofit	Battery Chargers, ENERGY STAR	ENERGY STAR Battery Chargers	Standard Battery Chargers	Existing	Per Charger	0	5	$10.00	50%	80%	$10.26	63
Electric	Energy Efficiency	Manufactured	Plug Load Other	Retrofit	Battery Chargers, ENERGY STAR	ENERGY STAR Battery Chargers	Standard Battery Chargers	New	Per Charger	0	5	$10.00	50%	80%	$10.26	23
Electric	Energy Efficiency	Multifamily	Plug Load Other	Retrofit	Battery Chargers, ENERGY STAR	ENERGY STAR Battery Chargers	Standard Battery Chargers	Existing	Per Charger	0	5	$10.00	50%	80%	$10.26	204
Electric	Energy Efficiency	Multifamily	Plug Load Other	Retrofit	Battery Chargers, ENERGY STAR	ENERGY STAR Battery Chargers	Standard Battery Chargers	New	Per Charger	0	5	$10.00	50%	80%	$10.26	73
Electric	Energy Efficiency	Single Family	Plug Load Other	Retrofit	Battery Chargers, ENERGY STAR	ENERGY STAR Battery Chargers	Standard Battery Chargers	Existing	Per Charger	0	5	$10.00	50%	80%	$10.26	600
Electric	Energy Efficiency	Single Family	Plug Load Other	Retrofit	Battery Chargers, ENERGY STAR	ENERGY STAR Battery Chargers	Standard Battery Chargers	New	Per Charger	0	5	$10.00	50%	80%	$10.26	214
Electric	Energy Efficiency	Single Family	Pool Pump	Retrofit	Pool Pump Timers	Pool Pump Timers	Pool Pump No Timers	Existing	Per Pool Pump Timer	1208	10	$61.91	95%	50%	-$0.01	3,012
Electric	Energy Efficiency	Manufactured	Refrigerator	Retrofit	Refrigerator/Freezer - Removal of Secondary	Proper Disposal of Refrigerator/Freezer	Existing Non-Efficient Refrigerator/Freezer	Existing	Per Refrigerator Removed	424	7	$125.00	24%	76%	$0.05	5,344
Electric	Energy Efficiency	Single Family	Refrigerator	Retrofit	Refrigerator/Freezer - Removal of Secondary	Proper Disposal of Refrigerator/Freezer	Existing Non-Efficient Refrigerator/Freezer	Existing	Per Refrigerator Removed	424	7	$125.00	46%	98%	$0.05	134,070
Electric	Energy Efficiency	Manufactured	Freezer	Retrofit	Stand-Alone Freezer - Removal	Proper Disposal of Freezer	Existing Non-Efficient Freezer	Existing	Per Freezer Removed	478	5	$125.00	54%	91%	$0.05	6,720
Electric	Energy Efficiency	Single Family	Freezer	Retrofit	Stand-Alone Freezer - Removal	Proper Disposal of Freezer	Existing Non-Efficient Freezer	Existing	Per Freezer Removed	478	5	$125.00	56%	99%	$0.05	49,950
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Green Roof	Ecoroof	Standard Roof	New	Per 100 Sqft of Roof Area	3	40	$48,722.00	20%	95%	$1,635.78	23
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Green Roof	Ecoroof	Standard Roof	New	Per 100 Sqft of Roof Area	3	40	$48,722.00	20%	95%	$1,635.78	22
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Green Roof	Ecoroof	Standard Roof	New	Per 100 Sqft of Roof Area	3	40	$48,722.00	20%	95%	$1,635.76	20
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Green Roof	Ecoroof	Standard Roof	New	Per 100 Sqft of Roof Area	3	40	$7,976.59	50%	95%	$267.89	12
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Green Roof	Ecoroof	Standard Roof	New	Per 100 Sqft of Roof Area	3	40	$7,976.59	50%	95%	$267.89	15

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Green Roof	Ecoroof	Standard Roof	New	Per 100 Sqft of Roof Area	3	40	$7,976.59	50%	95%	$267.87	1
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Green Roof	Ecoroof	Standard Roof	New	Per 100 Sqft of Roof Area	3	40	$41,491.86	50%	95%	$1,393.06	331
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Green Roof	Ecoroof	Standard Roof	New	Per 100 Sqft of Roof Area	3	40	$41,491.86	50%	95%	$1,393.06	142
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Green Roof	Ecoroof	Standard Roof	New	Per 100 Sqft of Roof Area	3	40	$41,491.86	50%	95%	$1,393.03	148
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)	Existing	Per Showerhead	153	10	$0.00	95%	31%	-$0.11	134
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)	New	Per Showerhead	153	10	$0.00	95%	85%	-$0.11	1,681
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)	Existing	Per Showerhead	165	10	$0.00	95%	79%	-$0.11	770
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)	New	Per Showerhead	165	10	$0.00	95%	85%	-$0.11	7,649
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)	Existing	Per Showerhead	169	10	$0.00	95%	79%	-$0.13	3,267
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)	New	Per Showerhead	169	10	$0.00	95%	85%	-$0.13	9,462
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	Existing	Per Home	16	20	$437.96	25%	95%	$2.97	29
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	New	Per Home	12	20	$437.96	25%	95%	$4.12	5
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	Existing	Per Home	19	20	$437.96	25%	95%	$2.61	32
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	New	Per Home	16	20	$437.96	25%	95%	$3.09	7
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	Existing	Per Home	17	20	$437.96	25%	95%	$2.94	31
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	New	Per Home	12	20	$437.96	25%	95%	$4.10	4
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	Existing	Per Home	19	20	$437.96	3%	95%	$2.63	4
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	New	Per Home	14	20	$437.96	3%	95%	$3.59	1
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	Existing	Per Home	7	20	$437.96	3%	95%	$7.16	2
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	New	Per Home	7	20	$437.96	3%	95%	$7.41	0
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	Existing	Per Home	18	20	$437.96	3%	95%	$2.68	1
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	New	Per Home	14	20	$437.96	3%	95%	$3.56	0
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	Existing	Per Home	36	20	$437.96	25%	95%	$1.34	584
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	New	Per Home	27	20	$437.96	25%	95%	$1.81	82
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	Existing	Per Home	3	20	$437.96	25%	95%	$14.37	20
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	New	Per Home	2	20	$437.96	25%	95%	$24.75	2
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	Existing	Per Home	36	20	$437.96	25%	95%	$1.31	302
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Solar Attic Fan	Solar electric attic ventilation	Standard passive ventilation	New	Per Home	27	20	$437.96	25%	95%	$1.78	35

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Programmable Thermostat	Programmable Thermostat	Manual Thermostat	Existing	Per Home	19	10	$29.00	95%	64%	-$2.11	146
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Programmable Thermostat	Programmable Thermostat	Manual Thermostat	Existing	Per Home	562	10	$29.00	95%	52%	-$0.02	8,682
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Programmable Thermostat	Programmable Thermostat	Manual Thermostat	Existing	Per Home	433	10	$29.00	95%	64%	-$0.01	3,128
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Programmable Thermostat	Programmable Thermostat	Manual Thermostat	Existing	Per Home	41	10	$29.00	95%	14%	-$1.13	788
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Programmable Thermostat	Programmable Thermostat	Manual Thermostat	Existing	Per Home	737	10	$29.00	95%	14%	-$0.03	3,452
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Programmable Thermostat	Programmable Thermostat	Manual Thermostat	Existing	Per Home	555	10	$29.00	95%	5%	-$0.03	1,344
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	Existing	Per Home	26	10	$167.45	25%	94%	$0.40	72
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	New	Per Home	19	10	$167.45	100%	95%	$0.97	64
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	Existing	Per Home	785	10	$167.45	25%	94%	$0.00	5,304
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	New	Per Home	382	10	$167.45	100%	95%	$0.04	3,328
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	Existing	Per Home	605	10	$167.45	25%	94%	$0.02	1,395
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	New	Per Home	301	10	$167.45	100%	95%	$0.06	1,141
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	Existing	Per Home	58	10	$167.45	25%	86%	-$0.64	1,789
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	New	Per Home	43	10	$167.45	100%	95%	-$0.12	2,053
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	Existing	Per Home	1030	10	$167.45	25%	86%	-$0.01	7,839
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	New	Per Home	481	10	$167.45	100%	95%	$0.02	4,592
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	Existing	Per Home	775	10	$167.45	25%	95%	$0.00	8,132
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	New	Per Home	392	10	$167.45	100%	95%	$0.03	4,581
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Whole House Fan	Whole House Fan	No Whole House Fan	Existing	Per Whole House Fan	225	20	$1,153.72	50%	95%	$0.57	9,729
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Whole House Fan	Whole House Fan	No Whole House Fan	New	Per Whole House Fan	167	20	$1,153.72	50%	95%	$0.77	2,004
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Whole House Fan	Whole House Fan	No Whole House Fan	Existing	Per Whole House Fan	225	20	$1,153.72	50%	95%	$0.54	4,269
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Whole House Fan	Whole House Fan	No Whole House Fan	New	Per Whole House Fan	167	20	$1,153.72	50%	95%	$0.74	741
Electric	Energy Efficiency	Manufactured	Cool Central	Retrofit	Window Overhang	Overhangs over windows for shading	No window overhangs	New	Per Window Overhang	15	45	$184.53	75%	50%	$1.23	26
Electric	Energy Efficiency	Manufactured	Cool Room	Retrofit	Window Overhang	Overhangs over windows for shading	No window overhangs	New	Per Window Overhang	20	45	$184.53	75%	50%	$0.92	26
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Window Overhang	Overhangs over windows for shading	No window overhangs	New	Per Window Overhang	28	45	$184.53	75%	50%	$0.63	29
Electric	Energy Efficiency	Multifamily	Cool Central	Retrofit	Window Overhang	Overhangs over windows for shading	No window overhangs	New	Per Window Overhang	32	25	$184.53	75%	50%	$0.64	70
Electric	Energy Efficiency	Multifamily	Cool Room	Retrofit	Window Overhang	Overhangs over windows for shading	No window overhangs	New	Per Window Overhang	15	25	$184.53	75%	50%	$1.32	34
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Window Overhang	Overhangs over windows for shading	No window overhangs	New	Per Window Overhang	79	25	$184.53	75%	50%	$0.23	14
Electric	Energy Efficiency	Single Family	Cool Central	Retrofit	Window Overhang	Overhangs over windows for shading	No window overhangs	New	Per Window Overhang	63	45	$184.53	75%	70%	$0.28	1,521

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Single Family	Cool Room	Retrofit	Window Overhang	Overhangs over windows for shading	No window overhangs	New	Per Window Overhang	5	45	$184.53	75%	50%	$3.97	25
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Window Overhang	Overhangs over windows for shading	No window overhangs	New	Per Window Overhang	81	45	$184.53	75%	50%	$0.19	339
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	564	30	$2,344.53	50%	85%	$0.41	4,821
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	414	30	$2,344.53	70%	75%	$0.57	1,391
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	363	30	$2,344.53	50%	85%	$0.66	1,312
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	270	30	$2,344.53	70%	75%	$0.89	328
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	583	30	$2,344.53	50%	85%	$0.40	262
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	443	30	$2,344.53	70%	75%	$0.53	67
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	880	30	$1,568.34	50%	85%	$0.16	5,141
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	597	30	$1,783.85	70%	75%	$0.28	1,233
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	769	30	$1,568.34	50%	85%	$0.19	488
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	535	30	$1,783.85	70%	75%	$0.32	134
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	401	30	$1,568.34	50%	85%	$0.38	21,903
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	275	30	$1,783.85	70%	75%	$0.65	5,392
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	807	30	$3,488.68	50%	75%	$0.42	7,153
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	557	30	$3,319.81	70%	75%	$0.59	1,978
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	503	30	$3,488.68	50%	75%	$0.70	6,790
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	372	30	$3,319.81	70%	75%	$0.91	1,576
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	574	30	$3,488.68	50%	75%	$0.60	8,856
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	405	30	$3,319.81	70%	75%	$0.83	2,129
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	2718	30	$3,020.50	50%	12%	$0.09	4,230
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	1833	30	$3,020.50	50%	12%	$0.15	997
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	2856	30	$3,020.50	50%	12%	$0.08	196
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	3005	30	$2,020.52	50%	14%	$0.04	3,080
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	2881	30	$2,020.52	50%	14%	$0.04	323
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	1369	30	$2,020.52	50%	14%	$0.12	13,323
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	3786	30	$4,494.53	50%	15%	$0.09	8,629
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	2488	30	$4,494.53	50%	15%	$0.16	7,109
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	2631	30	$4,494.53	50%	15%	$0.14	9,098

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Manufactured	Heat Central	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	3392	30	$8,978.91	50%	3%	$0.25	1,401
Electric	Energy Efficiency	Manufactured	Heat Pump	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	2316	30	$8,978.91	50%	3%	$0.39	337
Electric	Energy Efficiency	Manufactured	Heat Room	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	3577	30	$8,978.91	50%	3%	$0.24	63
Electric	Energy Efficiency	Multifamily	Heat Central	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	3459	30	$6,006.33	50%	4%	$0.15	989
Electric	Energy Efficiency	Multifamily	Heat Pump	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	3394	30	$6,006.33	50%	4%	$0.16	115
Electric	Energy Efficiency	Multifamily	Heat Room	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	1576	30	$6,006.33	50%	4%	$0.37	4,606
Electric	Energy Efficiency	Single Family	Heat Central	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	4686	30	$13,360.70	50%	5%	$0.26	2,700
Electric	Energy Efficiency	Single Family	Heat Pump	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	3128	30	$13,360.70	50%	5%	$0.42	2,824
Electric	Energy Efficiency	Single Family	Heat Room	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	3240	30	$13,360.70	50%	5%	$0.40	3,252
Electric	Energy Efficiency	Manufactured	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing - Home Entertainment Only	Standard Power Strip - Home Entertainment Only	Existing	Per Power Strip - Home Entertainment	43	5	$15.42	50%	85%	$0.07	1,383
Electric	Energy Efficiency	Manufactured	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing - Home Entertainment Only	Standard Power Strip - Home Entertainment Only	New	Per Power Strip - Home Entertainment	43	5	$15.42	50%	85%	$0.07	494
Electric	Energy Efficiency	Multifamily	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing - Home Entertainment Only	Standard Power Strip - Home Entertainment Only	Existing	Per Power Strip - Home Entertainment	43	5	$15.42	50%	85%	$0.07	4,448
Electric	Energy Efficiency	Multifamily	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing - Home Entertainment Only	Standard Power Strip - Home Entertainment Only	New	Per Power Strip - Home Entertainment	43	5	$15.42	50%	85%	$0.07	1,589
Electric	Energy Efficiency	Single Family	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing - Home Entertainment Only	Standard Power Strip - Home Entertainment Only	Existing	Per Power Strip - Home Entertainment	43	5	$15.42	50%	85%	$0.07	13,094
Electric	Energy Efficiency	Single Family	Plug Load Other	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing - Home Entertainment Only	Standard Power Strip - Home Entertainment Only	New	Per Power Strip - Home Entertainment	43	5	$15.42	50%	85%	$0.07	4,678
Electric	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)	Existing	Per Showerhead	153	10	$0.00	95%	25%	-$0.11	1,570
Electric	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)	Existing	Per Showerhead	165	10	$0.00	95%	80%	-$0.11	21,197
Electric	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)	Existing	Per Showerhead	169	10	$0.00	95%	79%	-$0.13	27,352
Electric	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)	New	Per Showerhead	153	10	$0.00	95%	85%	-$0.11	260
Electric	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)	New	Per Showerhead	165	10	$0.00	95%	85%	-$0.11	584
Electric	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)	New	Per Showerhead	169	10	$0.00	95%	85%	-$0.13	2,467
Electric	Fuel Conversion	SFam	Clothes Drying	Existing	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	Existing	Per installation	619	30	$196.88			$0.04	3,795
Electric	Fuel Conversion	SFam	Cooking	Existing	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Federal Standard 2012 Cooking Oven	Existing	Per installation	106	30	$455.62			$0.40	648
Electric	Fuel Conversion	SFam	Space Heating: Baseboard	Existing	Gas Fireplace	NA: manually populated- see cell	Electric Baseboard	Existing	Per installation	7211	30	$2,067.66			$0.05	298

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						comments associated with savings and cost cells										
Electric	Fuel Conversion	SFam	Space Heating: Baseboard	Existing	Wall Heater 84% eff	NA: manually populated- see cell comments associated with savings and cost cells	Electric Baseboard	Existing	Per installation	7211	30	$184.87			$0.01	473
Electric	Fuel Conversion	SFam	Water Heating	Existing	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	3889	30	$759.46			$0.04	113
Electric	Fuel Conversion	SFam	Water Heating	Existing	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	3889	30	$309.70			$0.03	108,977
Electric	Fuel Conversion	SFam	Zone Heating: Baseboard	Existing	Wall Heater 84% eff	NA: manually populated- see cell comments associated with savings and cost cells	Electric Baseboard	Existing	Per installation	7211	30	$184.87			$0.01	4,342
Electric	Fuel Conversion	SFam	Space Heating: Baseboard, Water Heating	Existing	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	Existing	Per installation	11099	30	$1,142.32			$0.07	4,591
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Existing	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	13
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Existing	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	13
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Existing	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	13
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Existing	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	13
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Existing	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	12,656
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Existing	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	527
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Existing	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	527
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Existing	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	527
Electric	Fuel Conversion	SFam	Clothes Drying	Main	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	Existing	Per installation	619	30	$196.88			$0.06	685
Electric	Fuel Conversion	SFam	Cooking	Main	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Federal Standard 2012 Cooking Oven	Existing	Per installation	106	30	$455.62			$0.42	117
Electric	Fuel Conversion	SFam	Space Heating: Baseboard	Main	Gas Fireplace	NA: manually populated- see cell comments associated with savings and cost cells	Electric Baseboard	Existing	Per installation	7211	30	$2,067.66			$0.05	915
Electric	Fuel Conversion	SFam	Space Heating: Baseboard	Main	Wall Heater 84% eff	NA: manually populated- see cell comments associated with savings and cost cells	Electric Baseboard	Existing	Per installation	7211	30	$184.87			$0.01	915
Electric	Fuel Conversion	SFam	Space Heating: Ducted	Main	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	Existing	Per installation	10839	30	$113.61			$0.03	39,654
Electric	Fuel Conversion	SFam	Space Heating: Ducted, Water Heating	Main	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	Existing	Per installation	14728	30	$397.90			$0.04	5,388
Electric	Fuel Conversion	SFam	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	3889	30	$759.46			$0.04	74

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Fuel Conversion	SFam	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	3889	30	$309.70			$0.04	71,726
Electric	Fuel Conversion	SFam	Space Heating: Baseboard, Water Heating	Main	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	Existing	Per installation	11099	30	$1,142.32			$0.07	14,080
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	6
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	6
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	6
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	6
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	3,405
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	142
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	142
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	142
Electric	Fuel Conversion	SFam	Clothes Drying	Main Ext - Short (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	Existing	Per installation	619	30	$196.88			$0.06	256
Electric	Fuel Conversion	SFam	Cooking	Main Ext - Short (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Federal Standard 2012 Cooking Oven	Existing	Per installation	106	30	$455.62			$0.42	44
Electric	Fuel Conversion	SFam	Space Heating: Baseboard	Main Ext - Short (ft)	Gas Fireplace	NA: manually populated- see cell comments associated with savings and cost cells	Electric Baseboard	Existing	Per installation	7211	30	$2,067.66			$0.05	341
Electric	Fuel Conversion	SFam	Space Heating: Baseboard	Main Ext - Short (ft)	Wall Heater 84% eff	NA: manually populated- see cell comments associated with savings and cost cells	Electric Baseboard	Existing	Per installation	7211	30	$184.87			$0.01	341
Electric	Fuel Conversion	SFam	Space Heating: Ducted	Main Ext - Short (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	Existing	Per installation	10839	30	$113.61			$0.03	14,792
Electric	Fuel Conversion	SFam	Space Heating: Ducted, Water Heating	Main Ext - Short (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	Existing	Per installation	14728	30	$397.90			$0.04	2,010
Electric	Fuel Conversion	SFam	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	3889	30	$759.46			$0.04	44
Electric	Fuel Conversion	SFam	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	3889	30	$309.70			$0.04	26,756
Electric	Fuel Conversion	SFam	Space Heating: Baseboard, Water Heating	Main Ext - Short (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	Existing	Per installation	11099	30	$1,142.32			$0.07	5,252
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	2
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	2
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	2
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						Tankless										
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	1,294
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	54
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	54
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	54
Electric	Fuel Conversion	SFam	Clothes Drying	Main Ext - Medium (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	Existing	Per installation	619	30	$196.88			$0.06	511
Electric	Fuel Conversion	SFam	Cooking	Main Ext - Medium (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Federal Standard 2012 Cooking Oven	Existing	Per installation	106	30	$455.62			$0.42	87
Electric	Fuel Conversion	SFam	Space Heating: Baseboard	Main Ext - Medium (ft)	Gas Fireplace	NA: manually populated- see cell comments associated with savings and cost cells	Electric Baseboard	Existing	Per installation	7211	30	$2,067.66			$0.05	682
Electric	Fuel Conversion	SFam	Space Heating: Baseboard	Main Ext - Medium (ft)	Wall Heater 84% eff	NA: manually populated- see cell comments associated with savings and cost cells	Electric Baseboard	Existing	Per installation	7211	30	$184.87			$0.01	682
Electric	Fuel Conversion	SFam	Space Heating: Ducted	Main Ext - Medium (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	Existing	Per installation	10839	30	$113.61			$0.03	29,585
Electric	Fuel Conversion	SFam	Space Heating: Ducted, Water Heating	Main Ext - Medium (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	Existing	Per installation	14728	30	$397.90			$0.04	4,020
Electric	Fuel Conversion	SFam	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	3889	30	$759.46			$0.04	88
Electric	Fuel Conversion	SFam	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	3889	30	$309.70			$0.04	53,513
Electric	Fuel Conversion	SFam	Space Heating: Baseboard, Water Heating	Main Ext - Medium (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	Existing	Per installation	11099	30	$1,142.32			$0.07	10,504
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	4
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	4
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	4
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$759.46			$0.06	4
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	2,588
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	108
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	108
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	Existing	Per installation	2778	30	$309.70			$0.05	108

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Fuel Conversion	MFam Mid Rise: Renter	Clothes Drying	Main	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	2
Electric	Fuel Conversion	MFam Mid Rise: Renter	Cooking	Main	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	0
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Baseboard	Main	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.14	7
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Baseboard, Water Heating	Main	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	20
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Ducted	Main	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.03	5
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Ducted, Water Heating	Main	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	1
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	0
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	19
Electric	Fuel Conversion	MFam Mid Rise: Owner	Clothes Drying	Main	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	1
Electric	Fuel Conversion	MFam Mid Rise: Owner	Cooking	Main	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	0
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Baseboard	Main	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.13	5
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Baseboard, Water Heating	Main	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	15
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Ducted	Main	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.02	4
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Ducted, Water Heating	Main	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	1
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	0
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	14
Electric	Fuel Conversion	MFam Low Rise: Renter	Clothes Drying	Main	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	42
Electric	Fuel Conversion	MFam Low Rise: Renter	Cooking	Main	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	3
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Baseboard	Main	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.13	163
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Baseboard, Water Heating	Main	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	474
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Ducted	Main	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.02	116
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Ducted, Water Heating	Main	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	22
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	1
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	448
Electric	Fuel Conversion	MFam Low Rise: Owner	Clothes Drying	Main	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	32
Electric	Fuel Conversion	MFam Low Rise: Owner	Cooking	Main	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Baseboard	Main	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.14	123
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Baseboard, Water Heating	Main	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	358
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Ducted	Main	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.03	88
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Ducted, Water Heating	Main	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	17
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	1
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	338
Electric	Fuel Conversion	MFam Mid Rise: Renter	Clothes Drying	Main Ext - Short (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	1
Electric	Fuel Conversion	MFam Mid Rise: Renter	Cooking	Main Ext - Short (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	0
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Baseboard	Main Ext - Short (ft)	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.14	3
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Baseboard, Water Heating	Main Ext - Short (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	7
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Ducted	Main Ext - Short (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.03	2
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Ducted, Water Heating	Main Ext - Short (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	0
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	0
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	7
Electric	Fuel Conversion	MFam Mid Rise: Owner	Clothes Drying	Main Ext - Short (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	0
Electric	Fuel Conversion	MFam Mid Rise: Owner	Cooking	Main Ext - Short (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	0
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Baseboard	Main Ext - Short (ft)	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.13	2
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Baseboard, Water Heating	Main Ext - Short (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	6
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Ducted	Main Ext - Short (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.02	1
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Ducted, Water Heating	Main Ext - Short (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	0
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	0
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	5
Electric	Fuel Conversion	MFam Low Rise: Renter	Clothes Drying	Main Ext - Short (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	16
Electric	Fuel Conversion	MFam Low Rise: Renter	Cooking	Main Ext - Short (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	1
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Baseboard	Main Ext - Short (ft)	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.13	61
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Baseboard, Water Heating	Main Ext - Short (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	177

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Ducted	Main Ext - Short (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.02	43
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Ducted, Water Heating	Main Ext - Short (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	8
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	0
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	167
Electric	Fuel Conversion	MFam Low Rise: Owner	Clothes Drying	Main Ext - Short (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	12
Electric	Fuel Conversion	MFam Low Rise: Owner	Cooking	Main Ext - Short (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	1
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Baseboard	Main Ext - Short (ft)	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.14	46
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Baseboard, Water Heating	Main Ext - Short (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	134
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Ducted	Main Ext - Short (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.03	33
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Ducted, Water Heating	Main Ext - Short (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	6
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	0
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	126
Electric	Fuel Conversion	MFam Mid Rise: Renter	Clothes Drying	Main Ext - Medium (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	1
Electric	Fuel Conversion	MFam Mid Rise: Renter	Cooking	Main Ext - Medium (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	0
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Baseboard	Main Ext - Medium (ft)	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.14	5
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Baseboard, Water Heating	Main Ext - Medium (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	15
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Ducted	Main Ext - Medium (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.03	4
Electric	Fuel Conversion	MFam Mid Rise: Renter	Space Heating: Ducted, Water Heating	Main Ext - Medium (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	1
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	0
Electric	Fuel Conversion	MFam Mid Rise: Renter	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	14
Electric	Fuel Conversion	MFam Mid Rise: Owner	Clothes Drying	Main Ext - Medium (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	1
Electric	Fuel Conversion	MFam Mid Rise: Owner	Cooking	Main Ext - Medium (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	0
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Baseboard	Main Ext - Medium (ft)	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.13	4
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Baseboard, Water Heating	Main Ext - Medium (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	11

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Ducted	Main Ext - Medium (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.02	3
Electric	Fuel Conversion	MFam Mid Rise: Owner	Space Heating: Ducted, Water Heating	Main Ext - Medium (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	1
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	0
Electric	Fuel Conversion	MFam Mid Rise: Owner	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	11
Electric	Fuel Conversion	MFam Low Rise: Renter	Clothes Drying	Main Ext - Medium (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	31
Electric	Fuel Conversion	MFam Low Rise: Renter	Cooking	Main Ext - Medium (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	2
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Baseboard	Main Ext - Medium (ft)	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.13	121
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Baseboard, Water Heating	Main Ext - Medium (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	354
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Ducted	Main Ext - Medium (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.02	87
Electric	Fuel Conversion	MFam Low Rise: Renter	Space Heating: Ducted, Water Heating	Main Ext - Medium (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	16
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	1
Electric	Fuel Conversion	MFam Low Rise: Renter	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	334
Electric	Fuel Conversion	MFam Low Rise: Owner	Clothes Drying	Main Ext - Medium (ft)	Dryer - Advanced Efficiency	Dryer - Advanced Efficiency	Dryer - Federal Standard 2015	New	Per installation	619	30	$196.88			$0.06	24
Electric	Fuel Conversion	MFam Low Rise: Owner	Cooking	Main Ext - Medium (ft)	Cooking Oven - High Efficiency	Cooking Oven - High Efficiency	Cooking Oven - Standard	New	Per installation	106	30	$455.62			$0.42	1
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Baseboard	Main Ext - Medium (ft)	95% Furnace	Furnace - Advanced Efficiency	Baseboard Heating	New	Per installation	1450	30	$315.74			$0.14	92
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Baseboard, Water Heating	Main Ext - Medium (ft)	Boiler	Integrated Space Heating and Water Heating	Baseboard Heating, Electric Water Heater, 55 gal.	New	Per installation	4227	30	$1,142.32			$0.12	267
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Ducted	Main Ext - Medium (ft)	95% Furnace	Furnace - Advanced Efficiency	Electric Furnace	New	Per installation	3152	30	-$396.64			$0.03	66
Electric	Fuel Conversion	MFam Low Rise: Owner	Space Heating: Ducted, Water Heating	Main Ext - Medium (ft)	Integrated Space & Water Heat	Integrated Space Heating and Water Heating	Electric Furnace, Electric Water Heater, 55 gal.	New	Per installation	5930	30	$397.90			$0.07	12
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$759.46			$0.06	0
Electric	Fuel Conversion	MFam Low Rise: Owner	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 55 gal.	New	Per installation	2778	30	$309.70			$0.05	252

Table 2 – Commercial Electric Measure Detail

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.28	100%	99%	$0.30	2,300
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.22	100%	99%	$0.44	591
Electric	Energy Efficiency	Dry Goods Retail	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	28
Electric	Energy Efficiency	Dry Goods Retail	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	12
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	15	$0.75	100%	99%	$0.33	861
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	1	30	$31.41	25%	100%	$4.50	621
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.59	100%	98%	$0.51	213
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	30	$25.12	25%	100%	$6.79	203
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	1	20	$2.50	100%	100%	$0.38	50,489
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	1	15	$0.12	95%	85%	$0.03	9,636
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	1	20	$0.14	50%	100%	-$0.01	26,928
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	2	13	$0.26	100%	100%	$0.01	40,206
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base CFL - Above Standard	CFL	EISA Standard Incandescent	Existing	Per Sqft	1	4	$0.02	50%	65%	-$0.02	4,225
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	1	12	$0.12	50%	98%	-$0.01	25,380
Electric	Energy Efficiency	Dry Goods Retail	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	217
Electric	Energy Efficiency	Dry Goods Retail	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	110
Electric	Energy Efficiency	Dry Goods Retail	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	Existing	Per Sqft	0	10	$0.00	100%	72%	-$0.02	1,212
Electric	Energy Efficiency	Dry Goods Retail	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	New	Per Sqft	0	10	$0.00	100%	72%	-$0.02	405

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.02	100%	100%	$0.73	65
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	20	$0.38	50%	100%	$6.16	486
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.02	100%	100%	$0.72	23
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	20	$0.38	50%	100%	$6.04	193
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	0	10	$0.30	100%	100%	$0.30	2,196
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	0	20	$0.95	50%	100%	$1.87	3,104
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	10	$0.29	100%	100%	$0.30	797
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	20	$0.94	50%	100%	$1.89	1,233
Electric	Energy Efficiency	Grocery	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.19	100%	99%	$0.22	448
Electric	Energy Efficiency	Grocery	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.15	100%	99%	$0.19	187
Electric	Energy Efficiency	Grocery	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	16
Electric	Energy Efficiency	Grocery	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	7
Electric	Energy Efficiency	Grocery	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	15	$0.50	100%	99%	$0.11	346
Electric	Energy Efficiency	Grocery	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	1	30	$20.95	25%	100%	$2.22	185
Electric	Energy Efficiency	Grocery	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.40	100%	98%	$0.33	39
Electric	Energy Efficiency	Grocery	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	1	30	$16.75	25%	100%	$3.51	46
Electric	Energy Efficiency	Grocery	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	1	20	$3.68	100%	100%	$0.36	10,957
Electric	Energy Efficiency	Grocery	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	1	15	$0.13	95%	85%	$0.01	1,892

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Grocery	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	1	20	$0.15	50%	100%	$0.00	5,142
Electric	Energy Efficiency	Grocery	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	2	13	$0.35	100%	100%	$0.01	7,179
Electric	Energy Efficiency	Grocery	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	1	12	$0.09	50%	98%	$0.00	2,410
Electric	Energy Efficiency	Grocery	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.01	100%	100%	$0.07	120
Electric	Energy Efficiency	Grocery	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.01	100%	100%	$0.07	61
Electric	Energy Efficiency	Grocery	Vending Machines	Equipment	Vending Machines-High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	Existing	Per Sqft	0	10	$0.01	100%	72%	$0.01	492
Electric	Energy Efficiency	Grocery	Vending Machines	Equipment	Vending Machines-High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	New	Per Sqft	0	10	$0.01	100%	72%	$0.01	166
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.03	100%	100%	$1.04	5
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	20	$0.68	50%	100%	$10.70	38
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.03	100%	100%	$1.00	2
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	20	$0.68	50%	100%	$10.25	14
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	0	10	$0.70	100%	100%	$0.75	173
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	0	20	$2.26	50%	100%	$4.34	242
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	10	$0.68	100%	100%	$0.72	64
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	20	$2.24	50%	100%	$4.27	99
Electric	Energy Efficiency	Hospital	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	Existing	Per Sqft	0	20	$0.33	100%	100%	$0.08	1,448
Electric	Energy Efficiency	Hospital	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	New	Per Sqft	0	20	$0.30	100%	99%	$0.29	229
Electric	Energy Efficiency	Hospital	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.19	100%	99%	$0.20	994
Electric	Energy Efficiency	Hospital	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.15	100%	99%	$0.57	132
Electric	Energy Efficiency	Hospital	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	74
Electric	Energy Efficiency	Hospital	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	31
Electric	Energy Efficiency	Hospital	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr -	Premium Efficiency Air Source Heat Pump	Federal Standard 2010 Air Source Heat	Existing	Per Sqft	0	15	$0.50	100%	99%	$0.16	306

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
					Premium Efficiency	65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP									
Electric	Energy Efficiency	Hospital	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	1	30	$20.95	25%	100%	$2.56	189
Electric	Energy Efficiency	Hospital	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.40	100%	98%	$0.27	62
Electric	Energy Efficiency	Hospital	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	30	$16.75	25%	100%	$5.12	41
Electric	Energy Efficiency	Hospital	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	1	20	$2.87	100%	100%	$0.45	13,808
Electric	Energy Efficiency	Hospital	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	15	$0.03	95%	85%	$0.19	462
Electric	Energy Efficiency	Hospital	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	20	$0.03	50%	100%	$0.02	1,264
Electric	Energy Efficiency	Hospital	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	1	13	$0.26	100%	100%	$0.02	11,149
Electric	Energy Efficiency	Hospital	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base CFL - Above Standard	CFL	EISA Standard Incandescent	Existing	Per Sqft	1	4	$0.02	50%	50%	-$0.01	231
Electric	Energy Efficiency	Hospital	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	1	12	$0.16	50%	98%	$0.00	9,659
Electric	Energy Efficiency	Hospital	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.03	100%	100%	$0.11	570
Electric	Energy Efficiency	Hospital	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.03	100%	100%	$0.11	290
Electric	Energy Efficiency	Hospital	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	Existing	Per Sqft	0	9	$0.07	100%	95%	$0.77	357
Electric	Energy Efficiency	Hospital	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	New	Per Sqft	0	9	$0.07	100%	95%	$0.77	113
Electric	Energy Efficiency	Hospital	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	Existing	Per Sqft	0	10	$0.01	100%	72%	$0.06	349
Electric	Energy Efficiency	Hospital	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	New	Per Sqft	0	10	$0.01	100%	72%	$0.06	118
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.07	100%	100%	$0.52	89
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	20	$1.84	50%	100%	$6.31	670
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.07	100%	100%	$0.50	32
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF	New	Per Sqft	0	20	$1.84	50%	100%	$6.10	264

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
							1.973									
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	1	10	$1.91	100%	100%	$0.44	3,016
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	1	20	$6.17	50%	100%	$2.53	4,255
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	1	10	$1.87	100%	100%	$0.43	1,109
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	1	20	$6.13	50%	100%	$2.52	1,716
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	Existing	Per Sqft	0	20	$0.33	100%	100%	$0.10	741
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	New	Per Sqft	0	20	$0.30	100%	99%	$0.27	108
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.19	100%	99%	$0.23	138
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.15	100%	99%	$0.53	20
Electric	Energy Efficiency	Hotel Motel	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.01	100%	100%	$0.19	65
Electric	Energy Efficiency	Hotel Motel	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.01	100%	100%	$0.19	28
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	15	$0.50	100%	99%	$0.14	682
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	1	30	$20.95	25%	100%	$2.55	403
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.40	100%	98%	$0.20	176
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	30	$16.75	25%	100%	$4.20	111
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	0	20	$1.17	100%	100%	$0.56	2,929
Electric	Energy Efficiency	Hotel Motel	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	15	$0.01	95%	85%	$0.27	120
Electric	Energy Efficiency	Hotel Motel	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	20	$0.01	50%	100%	$0.00	337
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package -	Standard Lighting Package	New	Per Sqft	1	13	$0.27	100%	100%	$0.02	4,718

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						25% LPD Reduction										
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base CFL - Above Standard	CFL	EISA Standard Incandescent	Existing	Per Sqft	3	4	$0.06	50%	59%	-$0.01	2,025
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	4	12	$0.49	50%	98%	$0.00	16,029
Electric	Energy Efficiency	Hotel Motel	Photo Copiers	Equipment	Copiers - ENERGY STAR	ENERGY STAR Copier	Standard Copier	Existing	Per Sqft	0	6	$0.00	100%	21%	-$0.02	1
Electric	Energy Efficiency	Hotel Motel	Photo Copiers	Equipment	Copiers - ENERGY STAR	ENERGY STAR Copier	Standard Copier	New	Per Sqft	0	6	$0.00	100%	21%	-$0.02	0
Electric	Energy Efficiency	Hotel Motel	Printers	Equipment	Printer - ENERGY STAR	ENERGY STAR Printer	Standard Printer	Existing	Per Sqft	0	6	$0.00	100%	1%	-$0.02	0
Electric	Energy Efficiency	Hotel Motel	Printers	Equipment	Printer - ENERGY STAR	ENERGY STAR Printer	Standard Printer	New	Per Sqft	0	6	$0.00	100%	1%	-$0.02	0
Electric	Energy Efficiency	Hotel Motel	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.05	100%	100%	$0.10	500
Electric	Energy Efficiency	Hotel Motel	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.05	100%	100%	$0.10	254
Electric	Energy Efficiency	Hotel Motel	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	Existing	Per Sqft	0	10	$0.01	100%	72%	$0.03	263
Electric	Energy Efficiency	Hotel Motel	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	New	Per Sqft	0	10	$0.01	100%	72%	$0.03	89
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.08	100%	100%	$0.48	38
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	20	$1.71	50%	100%	$4.67	279
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.08	100%	100%	$0.46	12
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	20	$1.71	50%	100%	$4.46	98
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	1	10	$1.77	100%	100%	$0.32	1,188
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	1	20	$5.69	50%	100%	$1.89	1,581
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	1	10	$1.73	100%	100%	$0.31	437
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	1	20	$5.65	50%	100%	$1.85	678
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	1	20	$2.81	100%	100%	$0.31	22,948
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	15	$0.03	95%	85%	$0.06	1,023
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	20	$0.04	50%	100%	-$0.03	2,869
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	2	13	$0.15	100%	100%	$0.00	13,947

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base CFL - Above Standard	CFL	EISA Standard Incandescent	Existing	Per Sqft	1	4	$0.01	50%	62%	-$0.03	970
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	1	12	$0.06	50%	98%	-$0.02	5,905
Electric	Energy Efficiency	Office	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	Existing	Per Sqft	0	20	$0.33	100%	100%	$0.07	10,766
Electric	Energy Efficiency	Office	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	New	Per Sqft	0	20	$0.30	100%	99%	$0.18	2,078
Electric	Energy Efficiency	Office	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.19	100%	99%	$0.25	4,222
Electric	Energy Efficiency	Office	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.15	100%	99%	$0.52	809
Electric	Energy Efficiency	Office	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	232
Electric	Energy Efficiency	Office	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	99
Electric	Energy Efficiency	Office	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	15	$0.50	100%	99%	$0.19	8,027
Electric	Energy Efficiency	Office	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	1	30	$20.95	25%	100%	$3.12	5,025
Electric	Energy Efficiency	Office	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.40	100%	98%	$0.34	1,728
Electric	Energy Efficiency	Office	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	30	$16.75	25%	100%	$5.39	1,415
Electric	Energy Efficiency	Office	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	1	20	$2.55	100%	100%	$0.45	127,459
Electric	Energy Efficiency	Office	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	15	$0.03	95%	85%	$0.11	5,448
Electric	Energy Efficiency	Office	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	20	$0.03	50%	100%	$0.00	13,531
Electric	Energy Efficiency	Office	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	1	13	$0.14	100%	100%	$0.00	71,280
Electric	Energy Efficiency	Office	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base CFL - Above Standard	CFL	EISA Standard Incandescent	Existing	Per Sqft	0	4	$0.00	50%	62%	-$0.02	4,028
Electric	Energy Efficiency	Office	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	0	12	$0.05	50%	98%	$0.00	27,895

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Office	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.01	100%	100%	$0.08	1,783
Electric	Energy Efficiency	Office	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.01	100%	100%	$0.08	907
Electric	Energy Efficiency	Office	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	Existing	Per Sqft	0	9	$0.11	100%	95%	$0.80	4,232
Electric	Energy Efficiency	Office	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	New	Per Sqft	0	9	$0.11	100%	95%	$0.80	1,355
Electric	Energy Efficiency	Office	Vending Machines	Equipment	Vending Machines-High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	Existing	Per Sqft	0	10	$0.00	100%	72%	-$0.02	4,293
Electric	Energy Efficiency	Office	Vending Machines	Equipment	Vending Machines-High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	New	Per Sqft	0	10	$0.00	100%	72%	-$0.02	1,437
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.01	100%	100%	$0.21	383
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	20	$0.35	50%	100%	$3.47	2,884
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.01	100%	100%	$0.20	142
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	20	$0.35	50%	100%	$3.32	1,168
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	0	10	$0.36	100%	100%	$0.26	12,958
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	0	20	$1.16	50%	100%	$1.42	18,384
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	10	$0.35	100%	100%	$0.25	4,829
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	20	$1.15	50%	100%	$1.39	7,475
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	Existing	Per Sqft	0	20	$0.36	100%	100%	$0.10	1,711
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	New	Per Sqft	0	20	$0.33	100%	99%	$0.19	384
Electric	Energy Efficiency	Other Commercial	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.20	100%	99%	$0.22	2,386
Electric	Energy Efficiency	Other Commercial	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.16	100%	99%	$0.36	545
Electric	Energy Efficiency	Other Commercial	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	142
Electric	Energy Efficiency	Other Commercial	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	60
Electric	Energy Efficiency	Other Commercial	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	15	$0.56	100%	99%	$0.23	1,416
Electric	Energy Efficiency	Other Commercial	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65	Advanced Efficiency Ground Source Heat Pump Replacing Air	Federal Standard 2010 Air Source Heat Pump 65 to 135	Existing	Per Sqft	1	30	$23.56	25%	100%	$3.31	956

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
					to 135 kBTU/hr - Advanced Efficiency	Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	kBTU/hr - 11.0 EER, 3.3 COP									
Electric	Energy Efficiency	Other Commercial	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.45	100%	98%	$0.38	272
Electric	Energy Efficiency	Other Commercial	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	30	$18.85	25%	100%	$5.48	243
Electric	Energy Efficiency	Other Commercial	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	0	20	$1.72	100%	100%	$0.56	42,120
Electric	Energy Efficiency	Other Commercial	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	1	15	$0.15	95%	85%	$0.04	16,070
Electric	Energy Efficiency	Other Commercial	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	1	20	$0.18	50%	100%	$0.01	45,108
Electric	Energy Efficiency	Other Commercial	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	1	13	$0.11	100%	100%	$0.00	35,395
Electric	Energy Efficiency	Other Commercial	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base CFL - Above Standard	CFL	EISA Standard Incandescent	Existing	Per Sqft	0	4	$0.01	50%	62%	-$0.01	2,460
Electric	Energy Efficiency	Other Commercial	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	0	12	$0.07	50%	98%	$0.01	17,493
Electric	Energy Efficiency	Other Commercial	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.01	100%	100%	$0.08	1,087
Electric	Energy Efficiency	Other Commercial	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.01	100%	100%	$0.08	553
Electric	Energy Efficiency	Other Commercial	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	Existing	Per Sqft	0	9	$0.57	100%	95%	$0.76	15,173
Electric	Energy Efficiency	Other Commercial	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	New	Per Sqft	0	9	$0.57	100%	95%	$0.76	4,931
Electric	Energy Efficiency	Other Commercial	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	Existing	Per Sqft	0	10	$0.01	100%	72%	$0.04	2,164
Electric	Energy Efficiency	Other Commercial	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	New	Per Sqft	0	10	$0.01	100%	72%	$0.04	725
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.02	100%	100%	$0.55	124
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	20	$0.50	50%	100%	$6.38	907
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.02	100%	100%	$0.53	39
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	20	$0.50	50%	100%	$6.18	318
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	0	10	$0.51	100%	100%	$0.44	4,146
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water	Existing	Per Sqft	0	20	$1.65	50%	100%	$2.52	5,727

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
							Heater - EF 0.93									
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	10	$0.50	100%	100%	$0.44	1,486
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	20	$1.64	50%	100%	$2.51	2,301
Electric	Energy Efficiency	Restaurant	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.36	100%	99%	$0.17	1,040
Electric	Energy Efficiency	Restaurant	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.29	100%	99%	$0.35	162
Electric	Energy Efficiency	Restaurant	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	16
Electric	Energy Efficiency	Restaurant	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	7
Electric	Energy Efficiency	Restaurant	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	15	$1.00	100%	99%	$0.30	323
Electric	Energy Efficiency	Restaurant	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	1	30	$41.89	25%	100%	$3.25	266
Electric	Energy Efficiency	Restaurant	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.79	100%	98%	$0.55	44
Electric	Energy Efficiency	Restaurant	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	1	30	$33.50	25%	100%	$6.13	51
Electric	Energy Efficiency	Restaurant	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	1	20	$1.74	100%	100%	$0.43	6,905
Electric	Energy Efficiency	Restaurant	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	15	$0.04	95%	85%	$0.25	558
Electric	Energy Efficiency	Restaurant	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	20	$0.04	50%	100%	-$0.07	1,530
Electric	Energy Efficiency	Restaurant	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	2	13	$0.34	100%	100%	$0.02	7,250
Electric	Energy Efficiency	Restaurant	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base CFL - Above Standard	CFL	EISA Standard Incandescent	Existing	Per Sqft	3	4	$0.05	50%	56%	-$0.02	1,134
Electric	Energy Efficiency	Restaurant	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	3	12	$0.36	50%	98%	$0.00	13,646
Electric	Energy Efficiency	Restaurant	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.01	100%	100%	$0.08	121
Electric	Energy Efficiency	Restaurant	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.01	100%	100%	$0.08	62

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.06	100%	100%	$0.06	199
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	1	20	$1.39	50%	100%	$0.74	1,461
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.06	100%	100%	$0.06	60
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	1	20	$1.39	50%	100%	$0.72	497
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	5	10	$1.43	100%	100%	$0.04	6,705
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	5	20	$4.65	50%	100%	$0.29	9,256
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	4	10	$1.40	100%	100%	$0.04	2,370
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	5	20	$4.62	50%	100%	$0.29	3,670
Electric	Energy Efficiency	School	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	Existing	Per Sqft	0	20	$0.43	100%	100%	$0.62	568
Electric	Energy Efficiency	School	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	New	Per Sqft	0	20	$0.39	100%	99%	$1.02	147
Electric	Energy Efficiency	School	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.24	100%	99%	$1.46	146
Electric	Energy Efficiency	School	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.20	100%	99%	$2.32	36
Electric	Energy Efficiency	School	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	54
Electric	Energy Efficiency	School	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	23
Electric	Energy Efficiency	School	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	15	$0.66	100%	99%	$0.23	1,840
Electric	Energy Efficiency	School	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	30	$27.92	25%	100%	$5.93	725
Electric	Energy Efficiency	School	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.54	100%	98%	$0.44	328
Electric	Energy Efficiency	School	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	30	$22.33	25%	100%	$10.29	178

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	School	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	0	20	$2.78	100%	100%	$0.63	25,277
Electric	Energy Efficiency	School	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	15	$0.08	95%	85%	$0.04	2,596
Electric	Energy Efficiency	School	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	20	$0.09	50%	100%	$0.02	7,095
Electric	Energy Efficiency	School	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	1	13	$0.15	100%	100%	$0.01	13,624
Electric	Energy Efficiency	School	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	0	12	$0.03	50%	98%	$0.02	1,551
Electric	Energy Efficiency	School	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.01	100%	100%	$0.09	418
Electric	Energy Efficiency	School	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.01	100%	100%	$0.09	213
Electric	Energy Efficiency	School	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	Existing	Per Sqft	0	9	$0.03	100%	95%	$0.76	302
Electric	Energy Efficiency	School	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	New	Per Sqft	0	9	$0.03	100%	95%	$0.76	97
Electric	Energy Efficiency	School	Vending Machines	Equipment	Vending Machines-High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	Existing	Per Sqft	0	10	$0.01	100%	72%	$0.04	918
Electric	Energy Efficiency	School	Vending Machines	Equipment	Vending Machines-High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	New	Per Sqft	0	10	$0.01	100%	72%	$0.04	311
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.02	100%	100%	$0.13	125
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	20	$0.38	50%	100%	$1.23	936
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.02	100%	100%	$0.13	43
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	20	$0.38	50%	100%	$1.24	354
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	1	10	$0.39	100%	100%	$0.08	4,207
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	1	20	$1.29	50%	100%	$0.48	5,938
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	1	10	$0.38	100%	100%	$0.08	1,487
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	1	20	$1.28	50%	100%	$0.50	2,301
Electric	Energy Efficiency	University	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	Existing	Per Sqft	0	20	$0.43	100%	100%	$0.62	30
Electric	Energy Efficiency	University	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	New	Per Sqft	0	20	$0.39	100%	99%	$1.02	8
Electric	Energy Efficiency	University	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.24	100%	99%	$1.46	12

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.20	100%	99%	$2.32	3
Electric	Energy Efficiency	University	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	21
Electric	Energy Efficiency	University	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	9
Electric	Energy Efficiency	University	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	15	$0.66	100%	99%	$0.23	39
Electric	Energy Efficiency	University	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	30	$27.92	25%	100%	$5.93	16
Electric	Energy Efficiency	University	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.54	100%	98%	$0.44	7
Electric	Energy Efficiency	University	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	30	$22.33	25%	100%	$10.29	4
Electric	Energy Efficiency	University	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	0	20	$2.08	100%	100%	$0.60	7,450
Electric	Energy Efficiency	University	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	15	$0.05	95%	85%	$0.04	658
Electric	Energy Efficiency	University	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	0	20	$0.06	50%	100%	$0.02	1,856
Electric	Energy Efficiency	University	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	1	13	$0.25	100%	100%	$0.03	5,351
Electric	Energy Efficiency	University	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	1	12	$0.14	50%	98%	$0.01	3,473
Electric	Energy Efficiency	University	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.01	100%	100%	$0.09	159
Electric	Energy Efficiency	University	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.01	100%	100%	$0.09	81
Electric	Energy Efficiency	University	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	Existing	Per Sqft	0	9	$0.03	100%	95%	$0.76	116
Electric	Energy Efficiency	University	Servers	Equipment	Server - High Efficiency	High Efficiency Server	Standard Server	New	Per Sqft	0	9	$0.03	100%	95%	$0.76	37
Electric	Energy Efficiency	University	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	Existing	Per Sqft	0	10	$0.01	100%	72%	$0.04	348
Electric	Energy Efficiency	University	Vending Machines	Equipment	Vending Machines- High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	New	Per Sqft	0	10	$0.01	100%	72%	$0.04	119
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.02	100%	100%	$0.13	48
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump	Existing	Per Sqft	0	20	$0.39	50%	100%	$1.24	357

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
							Water Heater - EF 1.973									
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.02	100%	100%	$0.13	16
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	20	$0.39	50%	100%	$1.24	135
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	1	10	$0.39	100%	100%	$0.08	1,603
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	1	20	$1.29	50%	100%	$0.49	2,262
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	1	10	$0.38	100%	100%	$0.08	566
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	1	20	$1.28	50%	100%	$0.51	877
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	Existing	Per Sqft	0	20	$0.25	100%	100%	$0.72	85
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Equipment	Chillers 150-300 tons (screw) - Advanced Efficiency	Advanced Efficiency Standard Chiller - 0.50 kW/Ton (Full Load)	Standard Chiller - 0.68 kW/Ton (Full Load)	New	Per Sqft	0	20	$0.22	100%	99%	$0.47	49
Electric	Energy Efficiency	Warehouse	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	Existing	Per Sqft	0	15	$0.14	100%	99%	$1.54	95
Electric	Energy Efficiency	Warehouse	Cooling DX	Equipment	DX Package 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency DX Package 65 to 135 kBTU/hr - 12 EER	Federal Standard 2010 DX Package 65 to 135 kBTU/hr - 11.2 EER	New	Per Sqft	0	15	$0.11	100%	99%	$0.91	53
Electric	Energy Efficiency	Warehouse	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	32
Electric	Energy Efficiency	Warehouse	Freezer	Equipment	Freezer - RTF Tier 3	RTF Tier 3 Freezer (ENERGY STAR 30% to 35% More Efficient)	RTF Market Standard Freezer	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	14
Electric	Energy Efficiency	Warehouse	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	15	$0.37	100%	99%	$0.54	203
Electric	Energy Efficiency	Warehouse	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	Existing	Per Sqft	0	30	$15.70	25%	100%	$11.27	98
Electric	Energy Efficiency	Warehouse	Heat Pump	Equipment	Air Source Heat Pump 65 to 135 kBTU/hr - Premium Efficiency	Premium Efficiency Air Source Heat Pump 65 to 135 kBTU/hr - 12.0 EER, 3.8 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	15	$0.30	100%	98%	$0.61	66
Electric	Energy Efficiency	Warehouse	Heat Pump	Equipment	Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - Advanced Efficiency	Advanced Efficiency Ground Source Heat Pump Replacing Air Source Heat Pump 65 to 135 kBTU/hr - 16.2 EER 4.0 COP	Federal Standard 2010 Air Source Heat Pump 65 to 135 kBTU/hr - 11.0 EER, 3.3 COP	New	Per Sqft	0	30	$12.57	25%	100%	$10.41	49
Electric	Energy Efficiency	Warehouse	Lighting Interior Fluorescent	Equipment	Lighting Interior - LED Tube - Above Standard	Above Standard LED Tube	Standard Fluorescent T-8	Existing	Per Sqft	0	20	$0.83	100%	100%	$0.50	15,861
Electric	Energy Efficiency	Warehouse	Lighting Interior HID	Equipment	Lighting Interior - High Bay Fluorescent High Output - Above Standard	High Bay Fluorescent High Output (HO)	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure	Existing	Per Sqft	1	15	$0.23	95%	85%	$0.03	14,230

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
							Sodium, Metal Halide									
Electric	Energy Efficiency	Warehouse	Lighting Interior HID	Equipment	Lighting Interior - High Bay LED - Above Standard	High Bay LED	Below Standard HID Baseline - represents a mix of Mercury Vapor, High Pressure Sodium, Metal Halide	Existing	Per Sqft	1	20	$0.26	50%	100%	$0.01	40,367
Electric	Energy Efficiency	Warehouse	Lighting Interior Other	Equipment	Lighting Package - Advanced Efficiency	Advanced Efficiency Lighting Package - 25% LPD Reduction	Standard Lighting Package	New	Per Sqft	0	13	$0.06	100%	100%	$0.00	15,139
Electric	Energy Efficiency	Warehouse	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base CFL - Above Standard	CFL	EISA Standard Incandescent	Existing	Per Sqft	0	4	$0.00	50%	60%	-$0.02	1,448
Electric	Energy Efficiency	Warehouse	Lighting Interior Screw Base	Equipment	Lighting Interior - Screw Base LED - Above Standard	LED	EISA Standard Incandescent	Existing	Per Sqft	0	12	$0.05	50%	98%	$0.00	10,733
Electric	Energy Efficiency	Warehouse	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	Existing	Per Sqft	0	20	$0.00	100%	100%	-$0.01	248
Electric	Energy Efficiency	Warehouse	Refrigerator	Equipment	Refrigerator - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Refrigerator	RTF Market Standard Refrigerator	New	Per Sqft	0	20	$0.00	100%	100%	-$0.01	126
Electric	Energy Efficiency	Warehouse	Vending Machines	Equipment	Vending Machines-High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	Existing	Per Sqft	0	10	$0.01	100%	72%	$0.12	585
Electric	Energy Efficiency	Warehouse	Vending Machines	Equipment	Vending Machines-High Efficiency	High Efficiency Vending Machines	Standard Vending Machines	New	Per Sqft	0	10	$0.01	100%	72%	$0.12	196
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	10	$0.00	100%	100%	-$0.02	70
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	Existing	Per Sqft	0	20	$0.07	50%	100%	$1.93	523
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	10	$0.00	100%	100%	-$0.02	26
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Heat Pump Water Heater - EF 1.973	New	Per Sqft	0	20	$0.07	50%	100%	$1.87	210
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	0	10	$0.07	100%	100%	$0.09	2,357
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	RTF Market Standard Storage Water Heater - EF 0.93	Existing	Per Sqft	0	20	$0.21	50%	100%	$0.56	3,338
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Heat Pump Water Heater - Advanced Efficiency	Advanced Efficiency Heat Pump Water Heater - EF 2.04	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	10	$0.07	100%	100%	$0.09	869
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Hot Water (SHW)	Federal Standard 2015 Storage Water Heater - EF 0.948	New	Per Sqft	0	20	$0.21	50%	100%	$0.56	1,346
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	Existing	0	113461	8	$16,039.42	90%	45%	$0.01	17,407
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	New	0	113461	8	$16,039.42	90%	45%	$0.01	6,254
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	Existing	0	1478	8	$208.91	15%	45%	$0.01	104
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	New	0	1478	8	$208.91	15%	45%	$0.01	62
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	Existing	0	417	8	$58.99	15%	45%	$0.01	57
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	New	0	417	8	$58.99	15%	45%	$0.01	104
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	Existing	0	3347	8	$473.12	25%	45%	$0.01	1,359

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	New	0	3347	8	$473.12	25%	45%	$0.01	523
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	Existing	0	4651	8	$657.45	15%	45%	$0.01	240
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	New	0	4651	8	$657.45	15%	45%	$0.01	111
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	Existing	0	4868	8	$688.17	15%	45%	$0.01	96
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Anti-Sweat (Humidistat) Controls	Anti-Sweat (Humidistat) Controls	No Anti-Sweat (Humidistat) Controls	New	0	4868	8	$688.17	15%	45%	$0.01	42
Electric	Energy Efficiency	Dry Goods Retail	Ventilation and Circulation	Retrofit	Automated Exhaust VFD Control - Parking Garage CO sensor	CO Sensors	No CO Sensors	Existing	0	14657	5	$2,133.33	1%	85%	$0.02	776
Electric	Energy Efficiency	Grocery	Ventilation and Circulation	Retrofit	Automated Exhaust VFD Control - Parking Garage CO sensor	CO Sensors	No CO Sensors	Existing	0	40786	5	$5,936.23	5%	85%	$0.02	635
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Automated Exhaust VFD Control - Parking Garage CO sensor	CO Sensors	No CO Sensors	Existing	0	21668	5	$3,153.63	20%	85%	$0.02	6,651
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Automated Exhaust VFD Control - Parking Garage CO sensor	CO Sensors	No CO Sensors	Existing	0	22305	5	$3,246.37	20%	85%	$0.02	2,997
Electric	Energy Efficiency	Office	Ventilation and Circulation	Retrofit	Automated Exhaust VFD Control - Parking Garage CO sensor	CO Sensors	No CO Sensors	Existing	0	9878	5	$1,437.68	20%	85%	$0.02	22,232
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Automated Exhaust VFD Control - Parking Garage CO sensor	CO Sensors	No CO Sensors	Existing	0	15295	5	$2,226.09	5%	85%	$0.02	6,391
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Automated Exhaust VFD Control - Parking Garage CO sensor	CO Sensors	No CO Sensors	Existing	0	34095	5	$4,962.32	1%	85%	$0.02	325
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Automated Exhaust VFD Control - Parking Garage CO sensor	CO Sensors	No CO Sensors	Existing	0	35688	5	$5,194.20	20%	85%	$0.02	2,398
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	2257	15	$2,875.00	25%	94%	$0.09	1,536
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	3015	15	$2,875.00	25%	94%	$0.10	390
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	3343	15	$4,250.00	5%	94%	-$0.16	116
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	5575	15	$4,250.00	5%	94%	$0.08	26
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	3364	15	$4,250.00	5%	94%	$0.11	45
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	609	15	$4,375.00	50%	94%	$0.79	24
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	1202	15	$4,375.00	50%	94%	$0.44	80
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	609	15	$4,375.00	50%	94%	$0.72	36
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors /	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	2465	15	$3,875.00	75%	94%	-$0.02	8,181

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
					CO_2 Sensors)											
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	4205	15	$3,875.00	75%	94%	$0.10	10,401
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	3445	15	$3,875.00	75%	94%	$0.05	5,909
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	2302	15	$3,000.00	50%	94%	$0.04	3,217
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	3264	15	$3,000.00	50%	94%	$0.10	1,253
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	2270	15	$3,000.00	50%	94%	$0.07	576
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	1892	15	$13,375.00	25%	94%	$0.14	94
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	13035	15	$13,375.00	25%	94%	$0.10	623
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	2064	15	$13,375.00	25%	94%	$0.16	95
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	1981	15	$14,000.00	25%	94%	-$0.06	7
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	13644	15	$14,000.00	25%	94%	$0.10	13
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO_2 Sensors)	Demand Controlled Ventilation (CO_2 sensors)	Constant Ventilation	Existing	0	2160	15	$14,000.00	25%	94%	-$0.41	4
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	1049	9	$618.13	10%	75%	$0.08	517
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	937	9	$618.13	10%	75%	$0.09	107
Electric	Energy Efficiency	Grocery	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	4439	9	$1,720.00	75%	75%	$0.05	943
Electric	Energy Efficiency	Grocery	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	3761	9	$1,720.00	75%	75%	$0.06	191
Electric	Energy Efficiency	Hospital	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	1399	9	$913.75	85%	75%	$0.09	1,597
Electric	Energy Efficiency	Hospital	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	1143	9	$913.75	85%	75%	$0.12	303

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	524	9	$940.63	85%	75%	$0.28	273
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	437	9	$940.63	85%	75%	$0.34	53
Electric	Energy Efficiency	Office	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	1214	9	$833.13	85%	75%	$0.10	11,036
Electric	Energy Efficiency	Office	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	1029	9	$833.13	85%	75%	$0.12	2,195
Electric	Energy Efficiency	Other Commercial	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	527	9	$645.00	25%	75%	$0.19	1,082
Electric	Energy Efficiency	Other Commercial	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	442	9	$645.00	25%	75%	$0.23	212
Electric	Energy Efficiency	Restaurant	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	237	9	$188.13	10%	75%	$0.12	73
Electric	Energy Efficiency	Restaurant	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	209	9	$188.13	10%	75%	$0.14	15
Electric	Energy Efficiency	School	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	3242	9	$2,875.63	50%	75%	$0.13	1,215
Electric	Energy Efficiency	School	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	2658	9	$2,875.63	50%	75%	$0.17	242
Electric	Energy Efficiency	University	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	2642	9	$3,010.00	50%	75%	$0.18	360
Electric	Energy Efficiency	University	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	2487	9	$3,010.00	50%	75%	$0.19	83
Electric	Energy Efficiency	Warehouse	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	1351	9	$3,251.88	10%	75%	$0.39	161
Electric	Energy Efficiency	Warehouse	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	889	9	$3,251.88	10%	75%	$0.59	25
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Case Electronically Commutated Motor	ECM Case Fans	Standard Efficiency Motor	Existing	0	15258	15	$673.28	100%	77%	-$0.01	4,781
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Case Electronically Commutated Motor	ECM Case Fans	Standard Efficiency Motor	Existing	0	334	15	$14.72	10%	77%	-$0.01	13
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Case Electronically Commutated Motor	ECM Case Fans	Standard Efficiency Motor	Existing	0	2670	15	$117.82	5%	77%	-$0.01	5
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Case Replacement Low Temp	Case Replacement Low Temp	No replacement	Existing	0	31279	15	$3,387.59	100%	98%	$0.00	12,809
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Case Replacement Low Temp	Case Replacement Low Temp	No replacement	Existing	0	171	15	$18.53	10%	98%	$0.00	18
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Case Replacement Low Temp	Case Replacement Low Temp	No replacement	Existing	0	2615	15	$283.18	5%	98%	$0.00	82

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Case Replacement Low Temp	Case Replacement Low Temp	No replacement	Existing	0	2737	15	$296.41	5%	98%	$0.00	34
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Case Replacement Med Temp	Case Replacement Med Temp	No replacement	Existing	0	2668	15	$1,755.08	100%	98%	$0.07	1,096
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Case Replacement Med Temp	Case Replacement Med Temp	No replacement	Existing	0	28	15	$18.65	5%	98%	$0.07	1
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Case Replacement Med Temp	Case Replacement Med Temp	No replacement	Existing	0	20	15	$13.16	3%	98%	$0.07	1
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Case Replacement Med Temp	Case Replacement Med Temp	No replacement	Existing	0	15	15	$9.60	10%	98%	$0.07	5
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Case Replacement Med Temp	Case Replacement Med Temp	No replacement	Existing	0	223	15	$146.71	5%	98%	$0.07	11
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Case Replacement Med Temp	Case Replacement Med Temp	No replacement	Existing	0	233	15	$153.57	5%	98%	$0.07	4
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	Existing	0	404	5	$170.34	95%	81%	$0.10	78
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	New	0	89	5	$170.34	95%	81%	$0.47	6
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	Existing	0	366	5	$170.34	95%	81%	$0.11	38
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	New	0	99	5	$170.34	95%	81%	$0.42	4
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	Existing	0	414	5	$170.34	95%	81%	$0.09	590
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	New	0	129	5	$170.34	95%	81%	$0.32	74
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	Existing	0	273	5	$170.34	95%	81%	$0.15	90
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	New	0	105	5	$170.34	95%	81%	$0.40	14
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	Existing	0	248	5	$170.34	95%	81%	$0.17	32
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	New	0	107	5	$170.34	95%	81%	$0.39	5
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	Existing	0	260	5	$170.34	95%	81%	$0.16	2
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	New	0	112	5	$170.34	95%	81%	$0.37	0
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	Existing	0	141	5	$170.34	95%	81%	$0.30	5
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Chilled Water / Condenser Water Settings-Optimization	Additional Control Features	EMS already installed - No Optimization	New	0	147	5	$170.34	95%	81%	$0.28	2
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	Existing	0	3955	10	$13,369.55	25%	70%	$0.52	151
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	New	0	833	10	$12,032.60	25%	70%	$2.24	14
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	Existing	0	3808	10	$13,762.78	25%	70%	$0.55	80
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed	New	0	971	10	$12,386.50	25%	70%	$1.98	8

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
							pump									
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	Existing	0	4180	10	$12,189.89	25%	70%	$0.45	1,233
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	New	0	1157	10	$10,970.90	25%	70%	$1.47	146
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	Existing	0	3114	10	$10,617.00	25%	70%	$0.53	214
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	New	0	1085	10	$9,555.30	25%	70%	$1.37	32
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	Existing	0	3804	10	$56,099.70	25%	70%	$2.29	100
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	New	0	1358	10	$50,489.74	25%	70%	$5.79	15
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	Existing	0	3457	10	$58,721.18	25%	70%	$2.64	4
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	New	0	1380	10	$52,849.06	25%	70%	$5.97	1
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	Existing	0	1347	10	$35,684.92	25%	70%	$4.13	10
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Chilled Water Piping Loop w/ VSD Control	VSD for secondary chilled water loop	Primary loop only w/ constant speed pump	New	0	1323	10	$32,116.43	25%	70%	$3.78	4
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Chiller-Water Side Economizer	Install Economizer	No Economizer	Existing	0	8152	15	$88,555.43	45%	90%	$1.37	686
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Chiller-Water Side Economizer	Install Economizer	No Economizer	Existing	0	7379	15	$91,160.00	45%	30%	$1.56	109
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Chiller-Water Side Economizer	Install Economizer	No Economizer	Existing	0	8347	15	$80,741.71	45%	45%	$1.22	2,552
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Chiller-Water Side Economizer	Install Economizer	No Economizer	Existing	0	5500	15	$70,323.43	45%	30%	$1.62	258
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Chiller-Water Side Economizer	Install Economizer	No Economizer	Existing	0	5000	15	$371,585.52	45%	90%	$9.43	266
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Chiller-Water Side Economizer	Install Economizer	No Economizer	Existing	0	5234	15	$388,949.32	45%	90%	$9.43	14
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Chiller-Water Side Economizer	Install Economizer	No Economizer	Existing	0	2839	15	$236,364.85	45%	90%	$10.57	42
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	3631	10	$241.65	1%	95%	-$0.01	11
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	1661	10	$241.65	1%	95%	$0.01	3
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	3405	10	$241.65	1%	95%	-$0.01	10
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	3457	10	$241.65	1%	95%	-$0.01	3
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	4612	10	$2,255.37	2%	95%	$0.06	12

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	2138	10	$2,255.37	2%	95%	$0.15	3
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	4326	10	$2,255.37	2%	95%	$0.07	11
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	4450	10	$2,255.37	2%	95%	$0.06	3
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	691	10	$80.55	0%	95%	$0.00	5
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	316	10	$80.55	0%	95%	$0.02	2
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	648	10	$80.55	0%	95%	$0.00	5
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	657	10	$80.55	0%	95%	$0.00	1
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	12217	10	$603.31	2%	95%	$0.00	34
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	5399	10	$603.31	2%	95%	$0.01	10
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	11459	10	$603.31	2%	95%	$0.00	33
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	11237	10	$603.31	2%	95%	$0.00	9
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	12787	10	$631.51	2%	95%	$0.00	13
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	5651	10	$631.51	2%	95%	$0.01	4
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	11994	10	$631.51	2%	95%	$0.00	13
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	11762	10	$631.51	2%	95%	$0.00	4
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	113	7	$43.17	95%	80%	$0.06	35
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	113	7	$43.17	95%	80%	$0.06	22
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43,	2013 Federal Standard Clothes Washer - MEF = 1.6,	Existing	0	113	7	$43.17	95%	80%	$0.06	36

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						WF = 4.0	WF = 8.5									
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	113	7	$43.17	95%	80%	$0.06	10
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	1050	7	$402.89	95%	80%	$0.06	118
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	1050	7	$402.89	95%	80%	$0.06	75
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	1050	7	$402.89	95%	80%	$0.06	121
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	1050	7	$402.89	95%	80%	$0.06	35
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	38	7	$14.39	95%	80%	$0.06	90
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	38	7	$14.39	95%	80%	$0.06	57
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	38	7	$14.39	95%	80%	$0.06	92
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	38	7	$14.39	95%	80%	$0.06	27
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	281	7	$107.77	95%	80%	$0.06	35
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	281	7	$107.77	95%	80%	$0.06	22
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	281	7	$107.77	95%	80%	$0.06	36
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	281	7	$107.77	95%	80%	$0.06	10
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	294	7	$112.81	95%	80%	$0.06	13
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	294	7	$112.81	95%	80%	$0.06	9
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	0	294	7	$112.81	95%	80%	$0.06	14
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	0	294	7	$112.81	95%	80%	$0.06	4

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	83	6	$9.63	70%	94%	$0.01	95
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	161	6	$18.65	70%	94%	$0.01	217
Electric	Energy Efficiency	Grocery	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	71	6	$8.26	70%	94%	$0.01	5
Electric	Energy Efficiency	Grocery	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	78	6	$9.06	70%	94%	$0.01	8
Electric	Energy Efficiency	Hospital	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	105	6	$12.09	70%	94%	$0.01	32
Electric	Energy Efficiency	Hospital	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	301	6	$34.83	70%	94%	$0.01	131
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	11	6	$1.27	70%	94%	$0.01	2
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	110	6	$12.71	70%	94%	$0.01	20
Electric	Energy Efficiency	Office	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	55	6	$6.30	70%	94%	$0.01	136
Electric	Energy Efficiency	Office	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	71	6	$8.25	70%	94%	$0.01	218
Electric	Energy Efficiency	Other Commercial	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	92	6	$10.59	70%	94%	$0.01	175
Electric	Energy Efficiency	Other Commercial	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	148	6	$17.10	70%	94%	$0.01	345
Electric	Energy Efficiency	Restaurant	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	34	6	$3.96	70%	94%	$0.01	25
Electric	Energy Efficiency	Restaurant	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	201	6	$23.24	70%	94%	$0.01	189
Electric	Energy Efficiency	School	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	139	6	$16.10	70%	94%	$0.01	25
Electric	Energy Efficiency	School	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	58	6	$6.76	70%	94%	$0.01	17
Electric	Energy Efficiency	University	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	364	6	$42.10	70%	94%	$0.01	24
Electric	Energy Efficiency	University	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	812	6	$93.87	70%	94%	$0.01	86
Electric	Energy Efficiency	Warehouse	Lighting Interior Other	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	New	0	44	6	$5.11	70%	94%	$0.01	12
Electric	Energy Efficiency	Warehouse	Lighting Interior Screw Base	Retrofit	Cold Cathode Lighting	Cold Cathode Lighting 5 watts	30 W Incandescent Bulb	Existing	0	98	6	$11.37	70%	94%	$0.01	34
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	Existing	0	831	10	$43.42	90%	90%	-$0.01	144
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	New	0	831	10	$43.42	90%	90%	-$0.01	51
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	Existing	0	63	10	$3.29	90%	90%	-$0.01	20
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	New	0	63	10	$3.29	90%	90%	-$0.01	10
Electric	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	Existing	0	202	10	$10.57	90%	90%	-$0.01	6
Electric	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	New	0	202	10	$10.57	90%	90%	-$0.01	4
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	Existing	0	121	10	$6.34	90%	90%	-$0.01	588
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	New	0	121	10	$6.34	90%	90%	-$0.01	202
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	Existing	0	6227	10	$325.56	90%	90%	-$0.01	3,981

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	New	0	6227	10	$325.56	90%	90%	-$0.01	1,295
Electric	Energy Efficiency	School	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	Existing	0	94	10	$4.92	90%	90%	-$0.01	34
Electric	Energy Efficiency	School	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	New	0	94	10	$4.92	90%	90%	-$0.01	15
Electric	Energy Efficiency	University	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	Existing	0	180	10	$9.39	90%	90%	-$0.01	28
Electric	Energy Efficiency	University	Cooking	Retrofit	Combination Oven	60% cooking efficiency	Non ENERGY STAR	New	0	180	10	$9.39	90%	90%	-$0.01	11
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	Existing	0	48293	10	$53,410.96	90%	85%	$0.16	15,522
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	New	0	48293	10	$53,410.96	90%	85%	$0.16	5,036
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	Existing	0	629	10	$695.67	90%	85%	$0.16	930
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	New	0	629	10	$695.67	90%	85%	$0.16	302
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	Existing	0	178	10	$196.42	90%	85%	$0.16	1,615
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	New	0	178	10	$196.42	90%	85%	$0.16	524
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	Existing	0	1425	10	$1,575.48	90%	85%	$0.16	4,896
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	New	0	1425	10	$1,575.48	90%	85%	$0.16	1,588
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	Existing	0	1980	10	$2,189.30	90%	85%	$0.16	1,714
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	New	0	1980	10	$2,189.30	90%	85%	$0.16	556
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	Existing	0	2072	10	$2,291.61	90%	85%	$0.16	652
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Commercial Refrigerator - Semivertical - No Doors - Med Temp	Standard Case	New	0	2072	10	$2,291.61	90%	85%	$0.16	212
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	Existing	0	18102	10	$72,408.27	90%	85%	$0.61	5,818
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	New	0	18102	10	$72,408.27	90%	85%	$0.61	1,888
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med	Standard Case	Existing	0	236	10	$943.10	90%	85%	$0.61	349

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						Temp										
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	New	0	236	10	$943.10	90%	85%	$0.61	113
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	Existing	0	67	10	$266.29	90%	85%	$0.61	606
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	New	0	67	10	$266.29	90%	85%	$0.61	196
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	Existing	0	534	10	$2,135.85	90%	85%	$0.61	1,835
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	New	0	534	10	$2,135.85	90%	85%	$0.61	595
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	Existing	0	742	10	$2,968.00	90%	85%	$0.61	642
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	New	0	742	10	$2,968.00	90%	85%	$0.61	208
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	Existing	0	777	10	$3,106.69	90%	85%	$0.61	245
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Commercial Refrigerator - Vertical - No Doors - Med Temp	Commercial Refrigerator - Vertical - No Doors - Med Temp	Standard Case	New	0	777	10	$3,106.69	90%	85%	$0.61	79
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Compressor VSD Retrofit	VSD Compressor	Constant Speed Compressor	Existing	0	4052	13	$1,600.00	60%	77%	$0.04	648
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Compressor VSD Retrofit	VSD Compressor	Constant Speed Compressor	Existing	0	29	13	$5.89	60%	77%	$0.01	148
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	5189	15	$34,943.57	15%	68%	$0.77	962
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	7978	15	$34,943.57	15%	68%	$0.54	324
Electric	Energy Efficiency	Dry Goods Retail	Ventilation and Circulation	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	7466	15	$34,943.57	15%	68%	$0.58	4,065
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	7688	15	$51,655.72	15%	68%	$0.48	470
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	14749	15	$51,655.72	15%	68%	$0.43	106
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	21851	15	$51,655.72	15%	68%	$0.28	3,264
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	7736	15	$51,655.72	15%	68%	$0.79	167
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	7002	15	$53,175.00	15%	68%	$0.82	58
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	15906	15	$53,175.00	15%	68%	$0.41	235

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	13575	15	$53,175.00	15%	68%	$0.48	860
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	7003	15	$53,175.00	15%	68%	$0.74	87
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	5667	15	$47,097.85	15%	68%	$0.80	1,877
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	11124	15	$47,097.85	15%	68%	$0.52	2,836
Electric	Energy Efficiency	Office	Ventilation and Circulation	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	5679	15	$47,097.85	15%	68%	$1.04	6,061
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	7921	15	$47,097.85	15%	68%	$0.64	1,322
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	5295	15	$36,462.85	15%	68%	$0.73	1,012
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	8636	15	$36,462.85	15%	68%	$0.52	512
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	6094	15	$36,462.85	15%	68%	$0.74	5,086
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	5219	15	$36,462.85	15%	68%	$0.77	202
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	4352	15	$162,563.57	15%	68%	$3.85	61
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	34485	15	$162,563.57	15%	68%	$0.57	537
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	16952	15	$162,563.57	15%	68%	$1.20	1,617
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	4746	15	$162,563.57	15%	68%	$3.57	70
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	4555	15	$170,160.00	15%	68%	$3.61	5
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	36096	15	$170,160.00	15%	68%	$0.57	11
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	17744	15	$170,160.00	15%	68%	$1.20	542
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	4967	15	$170,160.00	15%	68%	$2.89	4
Electric	Energy Efficiency	Grocery	Ventilation and Circulation	Retrofit	Cooking Hood Controls	Demand-Ventilation Control	No Controls	Existing	0	1119	18	$3,750.00	95%	65%	$0.38	253
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Cooking Hood Controls	Demand-Ventilation Control	No Controls	Existing	0	131	18	$437.50	95%	85%	$0.37	190
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Cooking Hood Controls	Demand-Ventilation Control	No Controls	Existing	0	1119	18	$3,750.00	95%	45%	$0.38	378
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Cooking Hood Controls	Demand-Ventilation Control	No Controls	Existing	0	93	18	$312.50	95%	65%	$0.37	566
Electric	Energy Efficiency	Restaurant	Ventilation and Circulation	Retrofit	Cooking Hood Controls	Demand-Ventilation Control	No Controls	Existing	0	1865	18	$6,250.00	95%	25%	$0.38	1,779
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Cooking Hood Controls	Demand-Ventilation Control	No Controls	Existing	0	1119	18	$3,750.00	95%	85%	$0.38	1,013

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Cooking Hood Controls	Demand-Ventilation Control	No Controls	Existing	0	1119	18	$3,750.00	95%	85%	$0.38	357
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	Existing	0	2588	8	$1,652.78	10%	94%	$0.11	69
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	New	0	571	8	$1,487.50	10%	94%	$0.46	5
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	Existing	0	2343	8	$1,701.39	10%	94%	$0.12	30
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	New	0	633	8	$1,531.25	10%	94%	$0.43	3
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	Existing	0	2650	8	$1,506.95	10%	94%	$0.09	472
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	New	0	826	8	$1,356.25	10%	94%	$0.29	58
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	Existing	0	1746	8	$1,312.50	10%	94%	$0.13	72
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	New	0	671	8	$1,181.25	10%	94%	$0.31	11
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	Existing	0	1587	8	$6,935.19	10%	94%	$0.78	24
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	New	0	686	8	$6,241.67	10%	94%	$1.64	4
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	Existing	0	1662	8	$7,259.26	10%	94%	$0.78	1
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	New	0	718	8	$6,533.33	10%	94%	$1.64	0
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	Existing	0	901	8	$4,411.45	10%	94%	$0.88	4
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Cooling Tower-Decrease Approach Temperature	6 Deg F	10 Deg F	New	0	940	8	$3,970.31	10%	94%	$0.76	1
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Cooling Tower-VSD Fan Control	Variable-Speed Tower Fans replace Two-Speed	Cooling Tower-Two-Speed Fan Motor	Existing	0	1956	13	$710.41	75%	75%	$0.04	326
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Cooling Tower-VSD Fan Control	Variable-Speed Tower Fans replace Two-Speed	Cooling Tower-Two-Speed Fan Motor	Existing	0	1753	13	$731.31	75%	75%	$0.05	141
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Cooling Tower-VSD Fan Control	Variable-Speed Tower Fans replace Two-Speed	Cooling Tower-Two-Speed Fan Motor	Existing	0	1986	13	$647.73	75%	75%	$0.04	2,519
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Cooling Tower-VSD Fan Control	Variable-Speed Tower Fans replace Two-Speed	Cooling Tower-Two-Speed Fan Motor	Existing	0	1196	13	$564.15	75%	75%	$0.06	346
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Cooling Tower-VSD Fan Control	Variable-Speed Tower Fans replace Two-Speed	Cooling Tower-Two-Speed Fan Motor	Existing	0	567	13	$2,980.96	75%	75%	$0.71	53
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Cooling Tower-VSD Fan Control	Variable-Speed Tower Fans replace Two-Speed	Cooling Tower-Two-Speed Fan Motor	Existing	0	1245	13	$3,120.27	75%	75%	$0.34	6
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Cooling Tower-VSD Fan Control	Variable-Speed Tower Fans replace Two-Speed	Cooling Tower-Two-Speed Fan Motor	Existing	0	676	13	$1,896.19	75%	75%	$0.38	19
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	1077	10	$299.67	20%	95%	$0.03	1,450
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	1077	10	$299.67	20%	95%	$0.03	470

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	2997	10	$833.87	20%	95%	$0.03	239
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	2997	10	$833.87	20%	95%	$0.03	78
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	1592	10	$442.99	20%	95%	$0.03	585
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	1592	10	$442.99	20%	95%	$0.03	190
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	1639	10	$456.02	20%	95%	$0.03	274
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	1639	10	$456.02	20%	95%	$0.03	89
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	1452	10	$403.91	20%	95%	$0.03	4,293
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	1452	10	$403.91	20%	95%	$0.03	1,393
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	1124	10	$312.70	20%	95%	$0.03	2,539
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	1124	10	$312.70	20%	95%	$0.03	824
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	328	10	$91.20	20%	95%	$0.03	280
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	328	10	$91.20	20%	95%	$0.03	91
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	5011	10	$1,394.13	20%	95%	$0.03	1,077
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	5011	10	$1,394.13	20%	95%	$0.03	350
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	5245	10	$1,459.27	20%	95%	$0.03	410
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	5245	10	$1,459.27	20%	95%	$0.03	133
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	Existing	0	5667	10	$1,576.54	20%	95%	$0.03	1,859
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Covered Parking Lighting	Covered Parking Lighting	Normal Lighting	New	0	5667	10	$1,576.54	20%	95%	$0.03	603
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	6103	10	$9,780.75	10%	80%	$0.24	1,198
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	15464	10	$18,144.00	10%	90%	$0.18	250
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	9041	10	$9,639.00	10%	30%	$0.16	168
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	8235	10	$9,922.50	10%	30%	$0.18	25
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	6665	10	$8,788.50	10%	20%	$0.20	546
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	6227	10	$7,654.50	10%	70%	$0.19	1,070
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	4052	10	$3,969.00	10%	50%	$0.15	347
Electric	Energy Efficiency	School	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	5118	10	$40,446.00	10%	60%	$1.23	53
Electric	Energy Efficiency	University	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	5357	10	$42,336.00	10%	60%	$1.23	4
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	DX Package-Air Side Economizer	Air-Side Economizer	No Economizer	Existing	0	3209	10	$25,727.63	10%	40%	$1.24	27
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	3051	5	$2,760.00	7%	75%	$0.22	375

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	7732	5	$5,120.00	7%	75%	$0.16	71
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	4521	5	$2,720.00	7%	75%	$0.14	146
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	4117	5	$2,800.00	7%	75%	$0.16	22
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	3332	5	$2,480.00	7%	75%	$0.18	664
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	3113	5	$2,160.00	7%	75%	$0.17	378
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	2026	5	$1,120.00	7%	75%	$0.13	131
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	2559	5	$11,413.34	7%	75%	$1.11	21
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	2678	5	$11,946.66	7%	75%	$1.11	2
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Economizer Tune-up	Economizer Tune-up	No Economizer Tune-Up	Existing	0	1605	5	$7,260.00	7%	75%	$1.13	17
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	691	8	$156.73	75%	70%	$0.03	2,526
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	1172	8	$266.03	75%	70%	$0.03	250
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	722	8	$163.74	75%	70%	$0.02	706
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	569	8	$129.02	75%	70%	$0.03	254
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	657	8	$149.15	75%	70%	$0.02	5,122
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	706	8	$160.16	75%	70%	$0.03	4,342
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	374	8	$84.95	75%	70%	$0.03	875
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	1538	8	$348.93	75%	70%	$0.03	890
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	1050	8	$238.33	75%	70%	$0.03	221
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Daylighting Controls, Outdoors (Photocell)	Photocell	No Controls	Existing	0	1643	8	$372.80	75%	70%	$0.02	1,393
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	Existing	0	34684	10	$69,392.40	95%	68%	$0.30	9,344
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	New	0	34684	10	$69,392.40	95%	68%	$0.30	3,032
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	Existing	0	452	10	$903.82	5%	68%	$0.30	29
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	New	0	452	10	$903.82	5%	68%	$0.30	10
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	Existing	0	128	10	$255.20	5%	68%	$0.30	51
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	New	0	128	10	$255.20	5%	68%	$0.30	17
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	Existing	0	1023	10	$2,046.89	5%	68%	$0.30	155
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	New	0	1023	10	$2,046.89	5%	68%	$0.30	50
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	Existing	0	1422	10	$2,844.38	5%	68%	$0.30	54
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	New	0	1422	10	$2,844.38	5%	68%	$0.30	18

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	Existing	0	1488	10	$2,977.30	5%	68%	$0.30	21
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Demand Control Defrost - Hot Gas	Refrigerant Defrost	Defrost - Electric	New	0	1488	10	$2,977.30	5%	68%	$0.30	7
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	166	10	$3,194.70	75%	94%	$2.99	232
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	75	10	$3,194.70	75%	94%	$6.65	64
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	156	10	$3,194.70	75%	94%	$3.19	224
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	156	10	$3,194.70	75%	94%	$3.19	63
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	487	10	$8,889.60	75%	94%	$2.83	18
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	225	10	$8,889.60	75%	94%	$6.15	5
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	457	10	$8,889.60	75%	94%	$3.02	17
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	468	10	$8,889.60	75%	94%	$2.95	5
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	1200	10	$4,722.60	55%	94%	$0.60	232
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	549	10	$4,722.60	55%	94%	$1.32	64
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	1126	10	$4,722.60	55%	94%	$0.64	222
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	1143	10	$4,722.60	55%	94%	$0.63	64
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	1525	10	$4,861.50	55%	80%	$0.48	83
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	707	10	$4,861.50	55%	80%	$1.06	21
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	1430	10	$4,861.50	55%	80%	$0.52	71
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	1471	10	$4,861.50	55%	80%	$0.50	22
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems	Constant Circulation	Existing	0	365	10	$4,305.90	55%	80%	$1.82	847

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						(VFD control by demand)										
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	169	10	$4,305.90	55%	80%	$3.96	241
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	342	10	$4,305.90	55%	80%	$1.95	816
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	351	10	$4,305.90	55%	80%	$1.90	235
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	229	10	$3,333.60	55%	94%	$2.26	312
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	104	10	$3,333.60	55%	94%	$4.97	77
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	214	10	$3,333.60	55%	94%	$2.41	298
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	217	10	$3,333.60	55%	94%	$2.38	85
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	1548	10	$972.30	75%	94%	$0.08	717
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	702	10	$972.30	75%	94%	$0.20	166
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	1452	10	$972.30	75%	94%	$0.09	673
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	1461	10	$972.30	75%	94%	$0.09	190
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	4039	10	$14,862.30	55%	94%	$0.56	324
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	1785	10	$14,862.30	55%	94%	$1.29	86
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	3788	10	$14,862.30	55%	94%	$0.60	311
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	3715	10	$14,862.30	55%	94%	$0.61	85
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	4227	10	$15,556.80	55%	94%	$0.56	123
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	1868	10	$15,556.80	55%	94%	$1.29	33

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	3965	10	$15,556.80	55%	94%	$0.60	118
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	3888	10	$15,556.80	55%	94%	$0.61	32
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	604	10	$16,806.90	55%	94%	$4.32	181
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	276	10	$16,806.90	55%	94%	$9.48	51
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	0	566	10	$16,806.90	55%	94%	$4.61	175
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	0	574	10	$16,806.90	55%	94%	$4.55	50
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	6487	8	$2,370.73	30%	84%	$0.05	10,477
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	5797	8	$2,370.73	30%	84%	$0.06	2,459
Electric	Energy Efficiency	Grocery	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	16174	8	$3,886.54	30%	96%	$0.03	1,719
Electric	Energy Efficiency	Grocery	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	13704	8	$3,886.54	30%	96%	$0.04	394
Electric	Energy Efficiency	Hospital	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	8282	8	$3,354.52	30%	51%	$0.06	2,200
Electric	Energy Efficiency	Hospital	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	6769	8	$3,354.52	30%	51%	$0.07	471
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	3936	8	$4,382.50	30%	92%	$0.19	806
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	3287	8	$4,382.50	30%	92%	$0.23	177
Electric	Energy Efficiency	Office	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	7893	8	$3,357.72	30%	78%	$0.06	25,556
Electric	Energy Efficiency	Office	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	6689	8	$3,357.72	30%	78%	$0.07	5,728
Electric	Energy Efficiency	Other Commercial	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	3190	8	$2,420.87	30%	84%	$0.12	8,371
Electric	Energy Efficiency	Other Commercial	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	2673	8	$2,420.87	30%	84%	$0.15	1,853
Electric	Energy Efficiency	Restaurant	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	2707	8	$1,331.22	30%	98%	$0.07	3,077
Electric	Energy Efficiency	Restaurant	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	2384	8	$1,331.22	30%	98%	$0.09	735
Electric	Energy Efficiency	School	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	9005	8	$4,953.95	30%	81%	$0.09	2,141

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	School	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	7383	8	$4,953.95	30%	81%	$0.11	483
Electric	Energy Efficiency	University	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	10745	8	$7,591.60	30%	81%	$0.11	929
Electric	Energy Efficiency	University	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	10115	8	$7,591.60	30%	81%	$0.12	241
Electric	Energy Efficiency	Warehouse	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	3514	8	$5,243.44	30%	98%	$0.25	1,550
Electric	Energy Efficiency	Warehouse	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	2313	8	$5,243.44	30%	98%	$0.39	270
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	5425	15	$23,958.33	50%	94%	$0.55	5,443
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	2682	15	$23,958.33	50%	94%	$1.13	1,156
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	13745	15	$66,666.67	50%	94%	$0.61	1,003
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	11528	15	$66,666.67	50%	94%	$0.73	365
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	8037	15	$35,416.67	50%	94%	$0.55	2,228
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	2096	15	$35,416.67	50%	94%	$2.14	258
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	7320	15	$36,458.33	50%	94%	$0.63	323
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	2324	15	$36,458.33	50%	94%	$1.99	41
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	5924	15	$32,291.67	50%	94%	$0.69	10,325
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	2109	15	$32,291.67	50%	94%	$1.94	1,605
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	5535	15	$25,000.00	50%	94%	$0.57	5,569
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	2464	15	$25,000.00	50%	94%	$1.28	1,082
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	3602	15	$7,291.67	50%	94%	$0.25	2,656
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	1348	15	$7,291.67	50%	94%	$0.68	319
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	4549	15	$111,458.33	50%	94%	$3.11	338
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	2189	15	$111,458.33	50%	94%	$6.46	70
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	4762	15	$116,666.67	50%	94%	$3.11	28
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	2291	15	$116,666.67	50%	94%	$6.46	6

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	Existing	0	2853	15	$126,041.67	50%	94%	$5.60	230
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Direct / Indirect Evaporative Cooling, Pre-Cooling	Evaporative Cooler	Standard DX cooling	New	0	3449	15	$126,041.67	50%	94%	$4.63	104
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	0	3713	8	$11,216.93	75%	59%	$0.46	1,035
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	0	5708	8	$11,216.93	75%	59%	$0.34	348
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	0	9408	8	$31,212.31	75%	61%	$0.38	228
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	0	25021	8	$31,212.31	75%	61%	$0.21	122
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	3713	8	$8,510.00	50%	80%	$0.32	3,263
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	5708	8	$8,510.00	50%	80%	$0.25	906
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	9408	8	$23,680.00	50%	80%	$0.23	569
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	25021	8	$23,680.00	50%	80%	$0.16	279
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	5501	8	$12,580.00	75%	80%	$0.04	2,348
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	10553	8	$12,580.00	75%	80%	$0.20	454
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	5535	8	$12,580.00	75%	80%	$0.35	784
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	5010	8	$12,950.00	50%	80%	$0.32	169
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	11381	8	$12,950.00	50%	80%	$0.19	686
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	5011	8	$12,950.00	50%	80%	$0.25	260
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	4055	8	$11,470.00	50%	80%	$0.26	6,186
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	7959	8	$11,470.00	50%	80%	$0.24	8,266
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	5668	8	$11,470.00	50%	80%	$0.26	4,032
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	3788	8	$8,880.00	50%	80%	$0.28	3,282
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	6179	8	$8,880.00	50%	80%	$0.24	1,397
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	3734	8	$8,880.00	50%	80%	$0.31	564

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Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	2466	8	$2,590.00	50%	100%	$0.16	1,637
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	2920	8	$2,590.00	50%	100%	$0.15	442
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	3114	8	$39,590.00	50%	80%	$1.40	137
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	24674	8	$39,590.00	50%	80%	$0.26	1,568
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	3395	8	$39,590.00	50%	80%	$1.33	194
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	25827	8	$41,440.00	50%	80%	$0.26	14
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	3554	8	$41,440.00	50%	80%	$0.65	3
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	1953	8	$44,770.00	50%	98%	$3.76	82
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	7553	8	$44,770.00	50%	98%	$1.04	184
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	1928	8	$44,770.00	50%	98%	$3.83	18
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	74	12	$42.32	95%	95%	$0.07	4
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	74	12	$42.32	95%	95%	$0.07	3
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	74	12	$42.32	95%	95%	$0.07	4
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	74	12	$42.32	95%	95%	$0.07	1
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	114	12	$65.11	95%	95%	$0.06	42
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	114	12	$65.11	95%	95%	$0.06	27
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	114	12	$65.11	95%	95%	$0.06	43
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	114	12	$65.11	95%	95%	$0.06	13
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	256	12	$145.60	95%	95%	$0.07	35
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	256	12	$145.60	95%	95%	$0.07	22
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	256	12	$145.60	95%	95%	$0.07	36
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	256	12	$145.60	95%	95%	$0.07	10
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	4	12	$2.51	95%	95%	$0.07	13

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	4	12	$2.51	95%	95%	$0.07	8
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	4	12	$2.51	95%	95%	$0.07	13
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	4	12	$2.51	95%	95%	$0.07	4
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	2856	12	$1,624.40	95%	95%	$0.07	1,945
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	2856	12	$1,624.40	95%	95%	$0.07	1,237
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	2856	12	$1,624.40	95%	95%	$0.07	2,001
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	2856	12	$1,624.40	95%	95%	$0.07	579
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	409	12	$232.68	95%	95%	$0.07	62
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	409	12	$232.68	95%	95%	$0.07	40
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	409	12	$232.68	95%	95%	$0.07	64
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	409	12	$232.68	95%	95%	$0.07	18
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	409	12	$232.68	95%	95%	$0.07	23
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	409	12	$232.68	95%	95%	$0.07	14
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	0	409	12	$232.68	95%	95%	$0.07	23
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - High Temp	High Efficiency Dishwasher (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	0	409	12	$232.68	95%	95%	$0.07	7
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	Existing	0	5307	8	$1,237.71	90%	85%	$0.03	1,411
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	New	0	5307	8	$1,237.71	90%	85%	$0.03	505
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	Existing	0	69	8	$16.12	90%	85%	$0.03	93
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	New	0	69	8	$16.12	90%	85%	$0.03	31
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	Existing	0	20	8	$4.55	90%	85%	$0.03	118
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	New	0	20	8	$4.55	90%	85%	$0.03	41
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	Existing	0	157	8	$36.51	90%	85%	$0.03	448
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	New	0	157	8	$36.51	90%	85%	$0.03	162
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	Existing	0	218	8	$50.73	90%	85%	$0.03	163
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	New	0	218	8	$50.73	90%	85%	$0.03	54

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	Existing	0	228	8	$53.10	90%	85%	$0.03	62
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Display Case Motion Sensors	Display Case Motion Sensors	No Motion Sensors	New	0	228	8	$53.10	90%	85%	$0.03	21
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	663	25	$1,250.03	5%	92%	$0.19	63
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	299	25	$1,250.03	25%	92%	$0.45	91
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	622	25	$1,250.03	5%	92%	$0.21	60
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	622	25	$1,250.03	25%	92%	$0.21	88
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	1949	25	$8,333.50	5%	92%	$0.46	5
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	900	25	$8,333.50	25%	92%	$1.01	7
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	1828	25	$8,333.50	5%	92%	$0.49	5
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	1872	25	$8,333.50	25%	92%	$0.48	7
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	4801	25	$12,083.58	5%	92%	$0.26	86
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	2196	25	$12,083.58	25%	92%	$0.59	123
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	4503	25	$12,083.58	5%	92%	$0.28	82
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	4571	25	$12,083.58	25%	92%	$0.28	122
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	6099	25	$11,458.56	5%	92%	$0.19	36
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	2827	25	$11,458.56	25%	92%	$0.43	46
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	5721	25	$11,458.56	5%	92%	$0.21	31
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	5885	25	$11,458.56	25%	92%	$0.20	49
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	1460	25	$2,083.38	5%	92%	$0.14	366
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	675	25	$2,083.38	25%	92%	$0.33	540
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	1369	25	$2,083.38	5%	92%	$0.15	352
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	1405	25	$2,083.38	25%	92%	$0.15	526
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	914	25	$2,291.71	5%	92%	$0.26	126
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water	Install (Power-Pipe or GFX) - Heat Recovery	No Heat Recovery System	New	0	417	25	$2,291.71	25%	92%	$0.59	149

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
					Heater	Water Heater										
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	857	25	$2,291.71	5%	92%	$0.28	121
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	868	25	$2,291.71	25%	92%	$0.28	180
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	6194	25	$1,875.04	5%	92%	$0.02	207
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	2807	25	$1,875.04	25%	92%	$0.06	301
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	5810	25	$1,875.04	5%	92%	$0.02	200
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	5842	25	$1,875.04	25%	92%	$0.02	293
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	16154	25	$7,916.83	5%	92%	$0.04	121
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	7139	25	$7,916.83	25%	92%	$0.11	169
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	15152	25	$7,916.83	5%	92%	$0.05	117
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	14858	25	$7,916.83	25%	92%	$0.05	166
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	16909	25	$8,333.50	5%	92%	$0.04	46
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	7473	25	$8,333.50	25%	92%	$0.11	64
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	15860	25	$8,333.50	5%	92%	$0.05	44
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	15553	25	$8,333.50	25%	92%	$0.05	63
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	2415	25	$1,458.36	5%	92%	$0.05	67
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	1103	25	$1,458.36	25%	92%	$0.13	98
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	0	2265	25	$1,458.36	5%	92%	$0.05	64
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	0	2297	25	$1,458.36	25%	92%	$0.05	95
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	1887	18	$8,625.00	45%	65%	$0.47	1,329
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	2901	18	$8,625.00	45%	65%	$0.33	392
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	4781	18	$16,000.00	45%	65%	$0.24	259
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	12715	18	$16,000.00	45%	65%	$0.13	151
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	2795	18	$8,500.00	45%	65%	$0.12	523

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	5363	18	$8,500.00	45%	65%	$0.17	147
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	2546	18	$8,750.00	45%	65%	$0.26	79
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	5783	18	$8,750.00	45%	65%	$0.16	313
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	2061	18	$7,750.00	45%	65%	$0.26	2,544
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	4045	18	$7,750.00	45%	65%	$0.20	3,752
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	1925	18	$6,750.00	45%	65%	$0.31	1,361
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	3140	18	$6,750.00	45%	65%	$0.23	615
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	1253	18	$3,500.00	45%	65%	$0.30	466
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	1484	18	$3,500.00	45%	65%	$0.26	164
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	1582	18	$35,666.67	45%	65%	$1.96	83
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	12539	18	$35,666.67	45%	65%	$0.30	624
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	1656	18	$37,333.33	45%	65%	$1.65	7
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	13125	18	$37,333.33	45%	65%	$0.30	13
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	992	18	$22,687.50	45%	65%	$2.41	60
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	3838	18	$22,687.50	45%	65%	$0.66	85
Electric	Energy Efficiency	Dry Goods Retail	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	0	5	$0.88	100%	20%	$1.01	0
Electric	Energy Efficiency	Dry Goods Retail	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	0	5	$0.88	100%	20%	$1.01	0
Electric	Energy Efficiency	Grocery	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	1	5	$3.75	100%	20%	$1.01	0
Electric	Energy Efficiency	Grocery	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	1	5	$3.75	100%	20%	$1.01	0
Electric	Energy Efficiency	Hospital	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	2	5	$7.10	100%	20%	$1.01	1
Electric	Energy Efficiency	Hospital	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	2	5	$7.10	100%	20%	$1.01	0
Electric	Energy Efficiency	Hotel Motel	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	0	5	$1.61	100%	20%	$1.01	0
Electric	Energy Efficiency	Hotel Motel	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	0	5	$1.61	100%	20%	$1.01	0
Electric	Energy Efficiency	Office	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	0	5	$0.70	100%	20%	$1.01	1
Electric	Energy Efficiency	Office	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	0	5	$0.70	100%	20%	$1.01	0
Electric	Energy Efficiency	Other Commercial	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	0	5	$0.82	100%	20%	$1.02	0
Electric	Energy Efficiency	Other Commercial	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	0	5	$0.82	100%	20%	$1.02	0
Electric	Energy Efficiency	Restaurant	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	0	5	$0.53	100%	20%	$1.01	0
Electric	Energy Efficiency	Restaurant	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	0	5	$0.53	100%	20%	$1.01	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	School	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	0	5	$0.13	100%	20%	$1.04	0
Electric	Energy Efficiency	School	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	0	5	$0.13	100%	20%	$1.04	0
Electric	Energy Efficiency	University	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	0	5	$0.13	100%	20%	$1.00	0
Electric	Energy Efficiency	University	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	0	5	$0.13	100%	20%	$1.00	0
Electric	Energy Efficiency	Warehouse	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	Existing	0	0	5	$1.83	100%	20%	$1.01	0
Electric	Energy Efficiency	Warehouse	Other Plug Load	Retrofit	ENERGY STAR - Battery Charging System	ENERGY STAR Battery Charging System	Non-ENERGY STAR Battery Chargers	New	0	0	5	$1.83	100%	20%	$1.01	0
Electric	Energy Efficiency	Dry Goods Retail	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	66	10	$0.19	95%	20%	-$0.02	89
Electric	Energy Efficiency	Dry Goods Retail	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	66	10	$0.19	95%	20%	-$0.02	29
Electric	Energy Efficiency	Grocery	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	64	10	$0.18	95%	20%	-$0.02	5
Electric	Energy Efficiency	Grocery	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	64	10	$0.18	95%	20%	-$0.02	2
Electric	Energy Efficiency	Hospital	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	269	10	$0.74	95%	20%	-$0.02	99
Electric	Energy Efficiency	Hospital	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	269	10	$0.74	95%	20%	-$0.02	32
Electric	Energy Efficiency	Hotel Motel	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	50	10	$0.13	95%	20%	-$0.02	8
Electric	Energy Efficiency	Hotel Motel	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	50	10	$0.13	95%	20%	-$0.02	3
Electric	Energy Efficiency	Office	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	427	10	$1.18	95%	20%	-$0.02	1,263
Electric	Energy Efficiency	Office	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	427	10	$1.18	95%	20%	-$0.02	410
Electric	Energy Efficiency	Other Commercial	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	44	10	$0.12	95%	20%	-$0.02	100
Electric	Energy Efficiency	Other Commercial	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	44	10	$0.12	95%	20%	-$0.02	32
Electric	Energy Efficiency	Restaurant	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	160	10	$0.44	95%	20%	-$0.02	137
Electric	Energy Efficiency	Restaurant	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	160	10	$0.44	95%	20%	-$0.02	44
Electric	Energy Efficiency	School	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	41	10	$0.11	95%	20%	-$0.02	9
Electric	Energy Efficiency	School	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	41	10	$0.11	95%	20%	-$0.02	3
Electric	Energy Efficiency	University	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	93	10	$0.26	95%	20%	-$0.02	7
Electric	Energy Efficiency	University	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	93	10	$0.26	95%	20%	-$0.02	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Warehouse	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	Existing	0	308	10	$0.86	95%	20%	-$0.02	101
Electric	Energy Efficiency	Warehouse	Other Plug Load	Retrofit	ENERGY STAR - Water Cooler	ENERGY STAR Water Cooler (Hot/Cold Water)	Non-ENERGY STAR Water Cooler	New	0	308	10	$0.86	95%	20%	-$0.02	33
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	Existing	0	3178	15	$22,988.88	90%	65%	$0.90	781
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	New	0	3178	15	$22,988.88	90%	65%	$0.90	253
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	Existing	0	37	15	$299.43	90%	65%	$1.02	42
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	New	0	37	15	$299.43	90%	65%	$1.02	14
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	Existing	0	7	15	$84.55	90%	65%	$1.57	47
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	New	0	7	15	$84.55	90%	65%	$1.57	15
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	Existing	0	92	15	$678.11	90%	65%	$0.92	241
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	New	0	92	15	$678.11	90%	65%	$0.92	78
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	Existing	0	109	15	$942.31	90%	65%	$1.08	72
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	New	0	109	15	$942.31	90%	65%	$1.08	23
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	Existing	0	114	15	$986.34	90%	65%	$1.08	27
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Evaporative Condenser - High-Efficiency	High-Efficiency Evaporative Condenser	Air-Cooled Condenser	New	0	114	15	$986.34	90%	65%	$1.08	9
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	Existing	0	643	16	$555.60	90%	85%	$0.09	162
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	New	0	643	16	$555.60	90%	85%	$0.09	59
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	Existing	0	214	16	$185.20	90%	85%	$0.09	277
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	New	0	214	16	$185.20	90%	85%	$0.09	91
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	Existing	0	214	16	$185.20	90%	85%	$0.09	1,274
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	New	0	214	16	$185.20	90%	85%	$0.09	439
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	Existing	0	429	16	$370.40	90%	85%	$0.09	1,177
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	New	0	429	16	$370.40	90%	85%	$0.09	425
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	Existing	0	429	16	$370.40	90%	85%	$0.09	305
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	New	0	429	16	$370.40	90%	85%	$0.09	102
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	Existing	0	429	16	$370.40	90%	85%	$0.09	111
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Evaporator Fan Controller	ECM Evaporator Fan Controller	No Controller	New	0	429	16	$370.40	90%	85%	$0.09	37

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	5004	14	$28,078.84	5%	94%	$0.72	92
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	2465	14	$28,078.84	5%	94%	$1.48	20
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	21933	14	$78,132.42	5%	94%	$0.45	32
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	7927	14	$78,132.42	5%	94%	$1.28	4
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	9251	14	$41,507.85	5%	94%	$0.57	30
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	3931	14	$41,507.85	5%	94%	$1.37	5
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	9976	14	$42,728.68	5%	94%	$0.55	66
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	5087	14	$42,728.68	5%	94%	$1.09	14
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	6977	14	$37,845.39	5%	94%	$0.69	799
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	3022	14	$37,845.39	5%	94%	$1.62	148
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	5417	14	$29,299.66	5%	94%	$0.69	145
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	2473	14	$29,299.66	5%	94%	$1.54	24
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	2560	14	$8,545.73	5%	94%	$0.43	37
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	1015	14	$8,545.73	5%	94%	$1.09	4
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	21629	14	$130,627.65	5%	94%	$0.76	152
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	9296	14	$130,627.65	5%	94%	$1.82	24
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	22640	14	$136,731.75	5%	94%	$0.76	3
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	9731	14	$136,731.75	5%	94%	$1.82	1
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	6621	14	$147,719.12	5%	94%	$2.90	18
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	4833	14	$147,719.12	5%	94%	$3.98	5
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	341	10	$439.33	64%	85%	$0.18	33
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	341	10	$439.33	64%	85%	$0.18	13

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Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	388	10	$439.33	64%	85%	$0.16	7
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	388	10	$439.33	64%	85%	$0.16	2
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	69	10	$88.86	62%	85%	$0.17	22
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	69	10	$88.86	62%	85%	$0.17	10
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	78	10	$88.86	62%	85%	$0.16	3
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	78	10	$88.86	62%	85%	$0.16	1
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	69	10	$88.86	62%	85%	$0.18	9
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	69	10	$88.86	62%	85%	$0.18	3
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	83	10	$106.96	58%	85%	$0.19	4
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	83	10	$106.96	58%	85%	$0.19	2
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	94	10	$106.96	58%	85%	$0.16	7
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	94	10	$106.96	58%	85%	$0.16	3
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	83	10	$106.96	58%	85%	$0.18	6
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	83	10	$106.96	58%	85%	$0.18	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	50	10	$64.17	100%	85%	$0.18	99
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	50	10	$64.17	100%	85%	$0.18	40
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	57	10	$64.17	100%	85%	$0.16	31
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	57	10	$64.17	100%	85%	$0.16	11
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	50	10	$64.17	100%	85%	$0.18	19
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	50	10	$64.17	100%	85%	$0.18	7
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	1203	10	$1,550.00	100%	85%	$0.18	1,726
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	1203	10	$1,550.00	100%	85%	$0.18	634
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	1368	10	$1,550.00	100%	85%	$0.16	427
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	1368	10	$1,550.00	100%	85%	$0.16	133
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	28	10	$36.20	73%	85%	$0.18	3
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	28	10	$36.20	73%	85%	$0.18	1
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	32	10	$36.20	73%	85%	$0.15	3
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	32	10	$36.20	73%	85%	$0.15	1

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	28	10	$36.20	73%	85%	$0.17	3
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	28	10	$36.20	73%	85%	$0.17	1
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	54	10	$69.11	73%	85%	$0.18	0
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	54	10	$69.11	73%	85%	$0.18	0
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	61	10	$69.11	73%	85%	$0.15	0
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	61	10	$69.11	73%	85%	$0.15	0
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	54	10	$69.11	73%	85%	$0.18	0
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	54	10	$69.11	73%	85%	$0.18	0
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Floating Condenser Head Pressure Controls	Floating Condenser Head Pressure Controls	No Floating Condenser Head Pressure Controls	Existing	0	22159	15	$7,538.71	50%	81%	$0.03	3,116
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Floating Condenser Head Pressure Controls	Floating Condenser Head Pressure Controls	No Floating Condenser Head Pressure Controls	New	0	22159	15	$7,538.71	50%	81%	$0.03	1,129
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Floating Condenser Head Pressure Controls	Floating Condenser Head Pressure Controls	No Floating Condenser Head Pressure Controls	Existing	0	81	15	$27.72	50%	81%	$0.03	159
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Floating Condenser Head Pressure Controls	Floating Condenser Head Pressure Controls	No Floating Condenser Head Pressure Controls	New	0	81	15	$27.72	50%	81%	$0.03	92
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	Existing	0	152	8	$36.39	35%	85%	$0.03	9
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	New	0	152	8	$36.39	35%	85%	$0.03	3
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	Existing	0	12	8	$2.76	25%	85%	$0.03	1
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000	15 inch width standard electric deep fat fryers	New	0	12	8	$2.76	25%	85%	$0.03	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						watt at idle										
Electric	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	Existing	0	37	8	$8.86	55%	85%	$0.03	1
Electric	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	New	0	37	8	$8.86	55%	85%	$0.03	0
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	Existing	0	37	8	$8.86	35%	85%	$0.03	67
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	New	0	37	8	$8.86	35%	85%	$0.03	23
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	Existing	0	1143	8	$272.85	70%	85%	$0.03	537
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	New	0	1143	8	$272.85	70%	85%	$0.03	175
Electric	Energy Efficiency	School	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	Existing	0	17	8	$4.12	35%	85%	$0.03	2
Electric	Energy Efficiency	School	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	New	0	17	8	$4.12	35%	85%	$0.03	1
Electric	Energy Efficiency	University	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	Existing	0	33	8	$7.87	35%	85%	$0.03	2
Electric	Energy Efficiency	University	Cooking	Retrofit	Fryers - New CEE Efficient Electric Deep Fat Fryers	15 inch width Deep Fryer CEE 2006 rating: 80% under heavy load, Less than 1000 watt at idle	15 inch width standard electric deep fat fryers	New	0	33	8	$7.87	35%	85%	$0.03	1
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Glass Door ENERGY STAR Refrigerators/Freezers	Glass Door ENERGY STAR Refrigerators/Freezers	Standard Glass Doors	New	0	48	12	$586.98	95%	77%	$1.72	5
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Glass Door ENERGY STAR Refrigerators/Freezers	Glass Door ENERGY STAR Refrigerators/Freezers	Standard Glass Doors	Existing	0	42	12	$603.90	95%	77%	$2.02	26
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Glass Door ENERGY STAR Refrigerators/Freezers	Glass Door ENERGY STAR Refrigerators/Freezers	Standard Glass Doors	New	0	42	12	$603.90	95%	77%	$2.02	19
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Glass Door ENERGY STAR Refrigerators/Freezers	Glass Door ENERGY STAR Refrigerators/Freezers	Standard Glass Doors	New	0	8	12	$187.31	95%	77%	$3.30	23
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Glass Door ENERGY STAR Refrigerators/Freezers	Glass Door ENERGY STAR Refrigerators/Freezers	Standard Glass Doors	New	0	4	12	$55.20	95%	77%	$2.02	4
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Glass Door ENERGY STAR Refrigerators/Freezers	Glass Door ENERGY STAR Refrigerators/Freezers	Standard Glass Doors	Existing	0	53	12	$756.86	95%	77%	$2.02	6

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Electric	Energy Efficiency	School	Refrigeration	Retrofit	Glass Door ENERGY STAR Refrigerators/Freezers	Glass Door ENERGY STAR Refrigerators/Freezers	Standard Glass Doors	New	0	53	12	$756.86	95%	77%	$2.02	14
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Glass Door ENERGY STAR Refrigerators/Freezers	Glass Door ENERGY STAR Refrigerators/Freezers	Standard Glass Doors	Existing	0	56	12	$792.23	95%	77%	$2.02	4
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Glass Door ENERGY STAR Refrigerators/Freezers	Glass Door ENERGY STAR Refrigerators/Freezers	Standard Glass Doors	New	0	56	12	$792.23	95%	77%	$2.02	5
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	115	40	$141,183.47	75%	98%	$123.17	150
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	47	40	$141,183.47	75%	98%	$302.26	28
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	177	40	$141,183.47	75%	98%	$80.11	50
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	72	40	$141,183.47	75%	98%	$197.35	9
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	292	40	$406,747.61	75%	98%	$140.05	29
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	202	40	$406,747.61	75%	98%	$202.61	9
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	778	40	$406,747.61	75%	98%	$52.65	18
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	232	40	$406,747.61	75%	98%	$176.79	2
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	171	40	$154,094.96	75%	98%	$90.74	64
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	37	40	$154,094.96	75%	98%	$422.21	6
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	328	40	$154,094.96	75%	98%	$47.29	17
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	115	40	$154,094.96	75%	98%	$135.06	2
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	172	40	$154,094.96	75%	98%	$90.17	23
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	31	40	$154,094.96	75%	98%	$495.59	2
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	156	40	$95,671.89	75%	98%	$61.86	9
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	41	40	$95,671.89	75%	98%	$236.42	1
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	354	40	$95,671.89	75%	98%	$27.22	36
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	149	40	$95,671.89	75%	98%	$64.78	6
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	156	40	$95,671.89	75%	98%	$61.84	12
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	35	40	$95,671.89	75%	98%	$277.57	1
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	126	40	$127,857.73	75%	98%	$102.14	291
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	37	40	$127,857.73	75%	98%	$348.13	38
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	247	40	$127,857.73	75%	98%	$52.02	437
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	88	40	$127,857.73	75%	98%	$145.78	67
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	176	40	$127,857.73	75%	98%	$73.07	183

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	45	40	$127,857.73	75%	98%	$284.41	19
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	118	40	$147,425.31	75%	98%	$126.06	158
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	43	40	$147,425.31	75%	98%	$343.66	26
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	192	40	$147,425.31	75%	98%	$77.27	80
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	72	40	$147,425.31	75%	98%	$205.38	11
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	116	40	$147,425.31	75%	98%	$127.88	29
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	37	40	$147,425.31	75%	98%	$403.49	4
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	77	40	$41,475.09	75%	98%	$54.49	67
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	24	40	$41,475.09	75%	98%	$176.70	8
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	91	40	$41,475.09	75%	98%	$46.00	20
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	30	40	$41,475.09	75%	98%	$140.80	2
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	97	40	$699,771.51	75%	98%	$728.05	10
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	38	40	$699,771.51	75%	98%	$1,835.83	2
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	767	40	$699,771.51	75%	98%	$91.84	84
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	272	40	$699,771.51	75%	98%	$259.34	11
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	106	40	$699,771.51	75%	98%	$667.62	9
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	38	40	$699,771.51	75%	98%	$1,873.82	1
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	101	40	$326,482.54	75%	98%	$324.51	1
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	40	40	$326,482.54	75%	98%	$818.28	0
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	803	40	$326,482.54	75%	98%	$40.92	2
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	284	40	$326,482.54	75%	98%	$115.58	0
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	110	40	$326,482.54	75%	98%	$297.58	0
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	39	40	$326,482.54	75%	98%	$835.21	0
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	61	40	$798,784.14	75%	98%	$1,325.21	6
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	60	40	$798,784.14	75%	98%	$1,330.05	2
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	235	40	$798,784.14	75%	98%	$342.56	10
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	141	40	$798,784.14	75%	98%	$569.44	2
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	Existing	0	60	40	$798,784.14	75%	98%	$1,342.48	1
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Green Roof	Vegetation on Roof	Standard Dark Colored Roof	New	0	52	40	$798,784.14	75%	98%	$1,561.63	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	Existing	0	322	12	$113.38	95%	35%	$0.04	25
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	New	0	322	12	$113.38	95%	35%	$0.04	8
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	Existing	0	65	12	$22.93	95%	35%	$0.03	13
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	New	0	65	12	$22.93	95%	35%	$0.03	4
Electric	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	Existing	0	78	12	$27.60	95%	35%	$0.04	2
Electric	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	New	0	78	12	$27.60	95%	35%	$0.04	1
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	Existing	0	78	12	$27.60	95%	35%	$0.04	165
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	New	0	78	12	$27.60	95%	35%	$0.04	54
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	Existing	0	1135	12	$400.00	95%	35%	$0.04	299
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	New	0	1135	12	$400.00	95%	35%	$0.04	97
Electric	Energy Efficiency	School	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	Existing	0	27	12	$9.34	95%	35%	$0.03	5
Electric	Energy Efficiency	School	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	New	0	27	12	$9.34	95%	35%	$0.03	2
Electric	Energy Efficiency	University	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	Existing	0	51	12	$17.83	95%	35%	$0.03	4
Electric	Energy Efficiency	University	Cooking	Retrofit	Griddle	70% cooking efficiency	Non ENERGY STAR	New	0	51	12	$17.83	95%	35%	$0.03	1
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	0	862	10	$228.30	19%	55%	$0.03	7
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	0	174	10	$46.17	7%	55%	$0.02	1
Electric	Energy Efficiency	Hotel Motel	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	0	210	10	$55.58	19%	55%	$0.03	0
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	0	210	10	$55.58	7%	55%	$0.03	17
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	Existing	0	3040	10	$805.45	40%	55%	$0.03	507
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	0	3040	10	$805.45	40%	55%	$0.03	170
Electric	Energy Efficiency	School	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	0	71	10	$18.81	26%	55%	$0.03	2
Electric	Energy Efficiency	University	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	0	136	10	$35.91	26%	55%	$0.03	1
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	Existing	0	7752	10	$7,518.61	85%	72%	$0.14	1,418
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	New	0	7752	10	$7,518.61	85%	72%	$0.14	569
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	Existing	0	303	10	$97.93	85%	72%	$0.04	285
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	New	0	303	10	$97.93	85%	72%	$0.04	107
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	Existing	0	56	10	$27.65	85%	72%	$0.06	120
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	New	0	56	10	$27.65	85%	72%	$0.06	81

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	Existing	0	755	10	$221.78	85%	72%	$0.03	1,685
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	New	0	755	10	$221.78	85%	72%	$0.03	624
Electric	Energy Efficiency	School	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	Existing	0	897	10	$308.19	85%	72%	$0.04	493
Electric	Energy Efficiency	School	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	New	0	897	10	$308.19	85%	72%	$0.04	179
Electric	Energy Efficiency	University	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	Existing	0	938	10	$322.58	85%	72%	$0.04	190
Electric	Energy Efficiency	University	Refrigeration	Retrofit	High-Efficiency Compressor	High-Efficiency Compressor (15% More Efficient)	Standard Compressor, 40% Efficiency	New	0	938	10	$322.58	85%	72%	$0.04	68
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	Existing	0	262	20	$146.59	55%	54%	$0.05	13
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	New	0	262	20	$146.59	55%	54%	$0.05	6
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	New	0	53	20	$29.65	15%	54%	$0.05	1
Electric	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	New	0	64	20	$35.69	55%	54%	$0.05	0
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	Existing	0	38	20	$21.41	15%	54%	$0.05	7
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	New	0	38	20	$21.41	15%	54%	$0.05	6
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	Existing	0	923	20	$517.17	35%	54%	$0.05	134
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	New	0	923	20	$517.17	35%	54%	$0.05	45
Electric	Energy Efficiency	School	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	Existing	0	22	20	$12.08	75%	54%	$0.05	1
Electric	Energy Efficiency	School	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	New	0	22	20	$12.08	75%	54%	$0.05	2
Electric	Energy Efficiency	University	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	Existing	0	41	20	$23.06	75%	54%	$0.05	2
Electric	Energy Efficiency	University	Cooking	Retrofit	Hot Food Holding Cabinet	ENERGY STAR Hot Food Holding Cabinet	Non ENERGY STAR Hot Food Holding Cabinet	New	0	41	20	$23.06	75%	54%	$0.05	1
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Hotel Occupancy Control System	Includes multiple hotel control schemes including: Key card system, room occupancy sensors, and front desk control to control room HVAC and lighting during non-occupied periods	325 sqft room, $100/room; No HVAC or lighting occupancy controls	New	0	483	15	$15,556.15	60%	97%	$4.08	9
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Hotel Occupancy Control System	Includes multiple hotel control schemes including: Key card system, room occupancy sensors, and front desk control to control room HVAC and lighting during	325 sqft room, $100/room; No HVAC or lighting occupancy controls	New	0	1764	15	$15,556.15	60%	97%	$1.10	60

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						non-occupied periods										
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	Existing	0	1096	8	$9.00	100%	86%	-$0.01	389
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	New	0	1096	8	$9.00	100%	86%	-$0.01	128
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	Existing	0	61	8	$0.50	100%	86%	-$0.01	97
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	New	0	61	8	$0.50	100%	86%	-$0.01	33
Electric	Energy Efficiency	Hotel Motel	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	Existing	0	365	8	$3.00	100%	86%	-$0.01	273
Electric	Energy Efficiency	Hotel Motel	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	New	0	365	8	$3.00	100%	86%	-$0.01	89
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	Existing	0	61	8	$0.50	100%	86%	-$0.01	609
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	New	0	61	8	$0.50	100%	86%	-$0.01	201
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	Existing	0	1036	8	$8.50	100%	86%	-$0.01	3,974
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	New	0	1036	8	$8.50	100%	86%	-$0.01	1,291
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	Existing	0	914	8	$7.50	100%	86%	-$0.01	880
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	New	0	914	8	$7.50	100%	86%	-$0.01	287
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	Existing	0	914	8	$7.50	100%	86%	-$0.01	320
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Ice Maker	High-Efficiency Ice Maker	Standard Ice Maker	New	0	914	8	$7.50	100%	86%	-$0.01	104
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1085	13	$782.39	10%	39%	-$0.07	125
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	3336	13	$782.39	10%	39%	$0.01	74
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	2749	13	$1,546.21	10%	39%	-$0.36	23
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	14622	13	$1,546.21	10%	39%	$0.00	26
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1607	13	$1,070.63	10%	39%	-$0.65	52
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	6167	13	$1,070.63	10%	39%	$0.01	25
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1617	13	$1,070.63	10%	39%	-$0.02	19
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1464	13	$2,269.19	10%	39%	-$0.07	7
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	6651	13	$2,269.19	10%	39%	$0.03	51
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1464	13	$2,269.19	10%	39%	-$0.22	9
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1185	13	$1,223.44	10%	39%	-$0.36	248

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	4651	13	$1,223.44	10%	39%	$0.01	647
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1656	13	$1,223.44	10%	39%	-$0.11	160
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1107	13	$417.73	10%	39%	-$0.23	131
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	3611	13	$417.73	10%	39%	$0.00	125
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1091	13	$417.73	10%	39%	-$0.18	24
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	720	13	$347.05	10%	39%	$0.01	57
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1707	13	$347.05	10%	39%	$0.01	34
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	910	13	$3,427.28	10%	39%	-$1.27	8
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	14419	13	$3,427.28	10%	39%	$0.00	129
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	992	13	$3,427.28	10%	39%	-$1.08	8
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	952	13	$3,587.43	10%	39%	-$1.75	1
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	15093	13	$3,587.43	10%	39%	$0.00	3
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	1039	13	$3,587.43	10%	39%	-$2.43	0
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	571	13	$1,036.14	10%	39%	-$0.51	5
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	4414	13	$1,036.14	10%	39%	$0.00	14
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	563	13	$1,036.14	10%	39%	-$0.46	1
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1	45	$1,121.61	25%	83%	$95.46	0
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	1	45	$1,121.61	75%	83%	$203.30	0
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	245	45	$1,121.61	25%	83%	$0.43	21
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	120	45	$1,121.61	75%	83%	$0.91	13
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	3	45	$3,231.34	25%	70%	$99.96	0
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	2	45	$3,231.34	75%	70%	$136.80	0
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	2190	45	$3,231.34	25%	70%	$0.13	15
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	204	45	$3,231.34	75%	70%	$1.56	1
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	2	45	$1,224.18	25%	70%	$58.93	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	0	45	$1,224.18	75%	70%	$231.20	0
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	608	45	$1,224.18	25%	70%	$0.18	10
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	368	45	$1,224.18	75%	70%	$0.31	5
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	2	45	$1,224.18	25%	70%	$62.56	0
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	0	45	$1,224.18	75%	70%	$307.67	0
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1	45	$760.06	25%	70%	$12.29	0
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	0	45	$760.06	75%	70%	$83.74	0
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	597	45	$760.06	25%	70%	$0.11	19
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	386	45	$760.06	75%	70%	$0.18	12
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1	45	$760.06	25%	70%	$38.16	0
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	0	45	$760.06	75%	70%	$157.53	0
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1	45	$1,015.76	25%	50%	$58.92	0
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	0	45	$1,015.76	75%	50%	$218.10	0
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	433	45	$1,015.76	25%	50%	$0.21	171
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	216	45	$1,015.76	75%	50%	$0.45	88
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	2	45	$1,015.76	25%	50%	$38.70	0
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	1	45	$1,015.76	75%	50%	$179.32	0
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1	45	$1,171.20	25%	70%	$84.55	0
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	0	45	$1,171.20	75%	70%	$223.35	0
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	336	45	$1,171.20	25%	70%	$0.33	36
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	164	45	$1,171.20	75%	70%	$0.69	18
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1	45	$1,171.20	25%	70%	$85.69	0
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	0	45	$1,171.20	75%	70%	$263.21	0
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1	45	$329.50	25%	83%	$43.29	0
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	0	45	$329.50	75%	83%	$118.81	0
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	65	45	$329.50	25%	83%	$0.49	3
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	45	45	$329.50	75%	83%	$0.72	3
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1852	45	$5,559.24	25%	70%	$0.27	62
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	796	45	$5,559.24	75%	70%	$0.66	24

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1938	45	$2,593.70	25%	70%	$0.10	1
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	833	45	$2,593.70	75%	70%	$0.28	1
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	1	45	$6,345.83	75%	70%	$901.26	0
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	788	45	$6,345.83	25%	70%	$0.77	10
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	449	45	$6,345.83	75%	70%	$1.37	6
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1	45	$6,345.83	25%	70%	$965.09	0
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	1	45	$6,345.83	75%	70%	$1,024.57	0
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1	45	$1,121.61	25%	98%	$67.68	0
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	1	45	$1,121.61	75%	98%	$171.96	0
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	91	45	$1,121.61	25%	98%	$1.21	9
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	45	45	$1,121.61	75%	98%	$2.48	6
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	3	45	$3,231.36	25%	85%	$27.43	0
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	2	45	$3,231.36	75%	85%	$118.38	0
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1273	45	$3,231.36	25%	85%	$0.24	9
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	50	45	$3,231.36	75%	85%	$6.40	0
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	2	45	$1,224.19	25%	85%	-$76.81	0
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	0	45	$1,224.19	75%	85%	-$276.60	0
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	352	45	$1,224.19	25%	85%	$0.33	6
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	252	45	$1,224.19	75%	85%	$0.47	4
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	2	45	$1,224.19	25%	85%	$55.52	0
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	0	45	$1,224.19	75%	85%	$275.87	0
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1	45	$760.04	25%	85%	$13.59	0
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	0	45	$760.04	75%	85%	$86.36	0
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	426	45	$760.04	25%	85%	$0.16	17
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	294	45	$760.04	75%	85%	$0.24	11
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1	45	$760.04	25%	85%	-$21.34	0
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	0	45	$760.04	75%	85%	-$0.44	0
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1	45	$1,015.74	25%	65%	$13.99	1
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	0	45	$1,015.74	75%	65%	$155.75	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	260	45	$1,015.74	25%	65%	$0.37	115
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	137	45	$1,015.74	75%	65%	$0.72	72
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	2	45	$1,015.74	25%	65%	$29.50	0
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	1	45	$1,015.74	75%	65%	$164.24	0
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1	45	$1,171.20	25%	85%	$55.27	0
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	0	45	$1,171.20	75%	85%	$189.72	0
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	144	45	$1,171.20	25%	85%	$0.79	17
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	73	45	$1,171.20	75%	85%	$1.57	10
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1	45	$1,171.20	25%	85%	$64.66	0
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	0	45	$1,171.20	75%	85%	$235.10	0
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1	45	$329.48	25%	98%	$35.44	0
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	0	45	$329.48	75%	98%	$103.22	0
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	19	45	$329.48	25%	98%	$1.75	1
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	17	45	$329.48	75%	98%	$1.96	1
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	2572	45	$5,559.24	25%	85%	$0.19	109
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	1106	45	$5,559.24	75%	85%	$0.47	41
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	2692	45	$2,593.70	25%	85%	$0.07	2
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	1157	45	$2,593.70	75%	85%	$0.19	1
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1	45	$6,345.83	25%	85%	$988.65	0
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	1	45	$6,345.83	75%	85%	$866.89	0
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	514	45	$6,345.83	25%	85%	$1.19	7
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	238	45	$6,345.83	75%	85%	$2.61	4
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1	45	$6,345.83	25%	85%	$970.24	0
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	1	45	$6,345.83	75%	85%	$1,026.20	0
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	99	45	$8,202.62	25%	85%	$3.93	37
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	2528	45	$8,202.62	25%	85%	$0.30	251
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	250	45	$23,631.63	25%	10%	-$1.63	1
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	21879	45	$23,631.63	25%	10%	$0.09	23
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	73	45	$8,952.76	25%	13%	-$15.33	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	4513	45	$8,952.76	25%	13%	$0.18	14
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	74	45	$8,952.76	25%	13%	$8.49	0
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	67	45	$5,558.44	25%	25%	$1.42	0
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	4427	45	$5,558.44	25%	25%	$0.11	52
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	67	45	$5,558.44	25%	25%	-$4.87	1
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	54	45	$7,428.40	25%	4%	$0.83	3
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	3216	45	$7,428.40	25%	4%	$0.21	104
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	76	45	$7,428.40	25%	4%	$4.09	1
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	51	45	$8,565.26	25%	30%	$7.86	7
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	2506	45	$8,565.26	25%	30%	$0.32	122
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	50	45	$8,565.26	25%	30%	$9.52	1
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	33	45	$2,409.66	25%	85%	$5.47	8
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	505	45	$2,409.66	25%	85%	$0.46	33
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	88704	45	$40,656.02	25%	15%	$0.02	767
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	92849	45	$18,968.30	25%	13%	-$0.01	14
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	52	45	$46,408.56	25%	10%	$74.35	0
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	7835	45	$46,408.56	25%	10%	$0.55	16
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	51	45	$46,408.56	25%	10%	$71.47	0
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	911	20	$2,834.63	75%	59%	$0.29	1,004
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	1401	20	$2,834.63	75%	59%	$0.21	332
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	2309	20	$7,887.68	75%	60%	$0.23	195
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	6141	20	$7,887.68	75%	60%	$0.13	116
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	1350	20	$4,190.34	75%	60%	$0.12	394
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	2590	20	$4,190.34	75%	60%	$0.16	112
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	1230	20	$4,313.57	75%	60%	$0.25	59
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	2793	20	$4,313.57	75%	60%	$0.15	236
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	995	20	$3,820.59	75%	59%	$0.25	1,879
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	1954	20	$3,820.59	75%	59%	$0.20	2,772
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	930	20	$2,957.88	75%	59%	$0.25	1,027

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	1517	20	$2,957.88	75%	59%	$0.20	523
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	605	20	$862.71	75%	56%	$0.14	441
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	717	20	$862.71	75%	56%	$0.12	138
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	764	20	$13,187.21	75%	55%	$1.26	58
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	6056	20	$13,187.21	75%	55%	$0.21	499
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	800	20	$13,803.44	75%	55%	$0.94	5
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	6339	20	$13,803.44	75%	55%	$0.21	11
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	479	20	$14,912.65	75%	58%	$3.22	41
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	1854	20	$14,912.65	75%	58%	$0.87	59
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	887	45	$10,918.19	35%	90%	$1.20	108
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	16618	45	$31,455.14	35%	45%	$0.17	108
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	2019	45	$11,916.68	35%	35%	$0.57	18
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	7707	45	$7,398.62	35%	45%	$0.08	237
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	3118	45	$9,887.66	35%	15%	$0.29	446
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	2174	45	$11,400.89	35%	50%	$0.50	242
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	68	45	$3,207.40	35%	90%	$4.70	6
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	31446	45	$54,115.67	35%	35%	$0.14	806
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	25135	45	$25,247.98	35%	35%	$0.07	13
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	9677	45	$61,772.64	35%	45%	$0.60	120
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	175	45	$1,788.32	35%	90%	$0.99	22
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	86	45	$1,788.32	35%	90%	$2.05	5
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	3238	45	$5,152.14	35%	45%	$0.14	21
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	40	45	$5,152.14	35%	45%	$12.70	0
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	831	45	$1,951.87	35%	35%	$0.21	8
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	663	45	$1,951.87	35%	35%	$0.27	2
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	1097	45	$1,211.85	35%	45%	$0.09	33
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	820	45	$1,211.85	35%	45%	$0.13	8
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	611	45	$1,619.53	35%	15%	$0.24	101
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	339	45	$1,619.53	35%	15%	$0.45	19

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	315	45	$1,867.38	35%	50%	$0.57	32
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	164	45	$1,867.38	35%	50%	$1.11	6
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	15	45	$525.35	35%	90%	$3.57	1
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	30	45	$525.35	35%	90%	$1.73	1
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	6111	45	$8,863.77	35%	35%	$0.11	157
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	2534	45	$8,863.77	35%	35%	$0.32	18
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	4886	45	$4,135.45	35%	35%	$0.05	3
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	2042	45	$4,135.45	35%	35%	$0.17	0
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	1352	45	$10,117.93	35%	45%	$0.71	16
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	593	45	$10,117.93	35%	45%	$1.66	2
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	1101	45	$8,787.76	10%	35%	$0.77	15
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	18074	45	$22,153.46	10%	35%	$0.11	27
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	6904	45	$9,105.59	10%	35%	$0.11	24
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	14787	45	$14,308.63	10%	35%	$0.08	99
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	5627	45	$13,364.83	10%	35%	$0.21	637
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	1901	45	$6,977.60	10%	35%	$0.35	43
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	145	45	$3,663.90	10%	35%	$2.51	2
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	54624	45	$16,486.32	10%	35%	$0.00	449
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	57177	45	$17,256.71	10%	35%	$0.00	9
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	7187	45	$36,252.27	10%	35%	$0.47	20
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	1073	30	$1,725.00	10%	95%	$0.11	103
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	1643	30	$1,725.00	10%	95%	$0.09	29
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	4611	30	$4,800.00	10%	95%	$0.07	30
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	5285	30	$4,800.00	10%	95%	$0.08	6
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	838	30	$2,550.00	10%	95%	-$0.51	23
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	2621	30	$2,550.00	10%	95%	$0.08	7
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	930	30	$2,625.00	10%	95%	$0.01	4

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	3392	30	$2,625.00	10%	95%	$0.06	20
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	844	30	$2,325.00	10%	95%	$0.09	147
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	2014	30	$2,325.00	10%	95%	$0.10	217
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	985	30	$1,800.00	10%	95%	$0.10	89
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	1649	30	$1,800.00	10%	95%	$0.10	44
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	539	30	$525.00	10%	95%	$0.07	36
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	677	30	$525.00	10%	95%	$0.07	11
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	876	30	$8,025.00	10%	95%	$0.16	6
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	6197	30	$8,025.00	10%	95%	$0.11	43
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	917	30	$8,400.00	10%	95%	$0.06	1
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	6487	30	$8,400.00	10%	95%	$0.11	1
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	1380	30	$9,075.00	10%	95%	$0.59	8
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	3222	30	$9,075.00	10%	95%	$0.26	8
Electric	Energy Efficiency	Dry Goods Retail	Ventilation and Circulation	Retrofit	Low Pressure Distribution Complex HVAC	Low Pressure Distribution Complex HVAC	VAV/CV	New	0	8625	50	$25,300.00	8%	98%	$0.27	1,185
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Low Pressure Distribution Complex HVAC	Low Pressure Distribution Complex HVAC	VAV/CV	New	0	12750	50	$37,400.00	24%	98%	$0.27	1,523
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Low Pressure Distribution Complex HVAC	Low Pressure Distribution Complex HVAC	VAV/CV	New	0	13125	50	$38,500.00	8%	98%	$0.27	229
Electric	Energy Efficiency	Office	Ventilation and Circulation	Retrofit	Low Pressure Distribution Complex HVAC	Low Pressure Distribution Complex HVAC	VAV/CV	New	0	13950	50	$34,100.00	17%	98%	$0.22	8,654
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Low Pressure Distribution Complex HVAC	Low Pressure Distribution Complex HVAC	VAV/CV	New	0	9000	50	$26,400.00	16%	98%	$0.27	3,902
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Low Pressure Distribution Complex HVAC	Low Pressure Distribution Complex HVAC	VAV/CV	New	0	40125	50	$117,700.00	15%	98%	$0.27	1,798
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Low Pressure Distribution Complex HVAC	Low Pressure Distribution Complex HVAC	VAV/CV	New	0	42000	50	$123,200.00	15%	98%	$0.27	664
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	44	9	$3.89	95%	25%	$0.00	22
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	41	9	$3.89	95%	25%	$0.00	22
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	130	9	$10.82	95%	25%	$0.00	2
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	122	9	$10.82	95%	25%	$0.00	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	320	9	$14.37	95%	25%	-$0.01	31
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	300	9	$14.37	95%	25%	-$0.01	30
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	407	9	$59.15	95%	25%	$0.01	15
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	381	9	$59.15	95%	25%	$0.01	14
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	97	9	$5.24	95%	25%	-$0.01	130
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	91	9	$5.24	95%	25%	-$0.01	126
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	61	9	$4.06	95%	25%	$0.00	46
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	57	9	$4.06	95%	25%	$0.00	44
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	413	9	$3.38	95%	25%	-$0.01	74
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	387	9	$3.38	95%	25%	-$0.01	71
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	1077	9	$18.08	95%	25%	-$0.01	43
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	1010	9	$18.08	95%	25%	-$0.01	42
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	1127	9	$18.93	95%	25%	-$0.01	16
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	1057	9	$18.93	95%	25%	-$0.01	16
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	161	9	$4.09	95%	25%	-$0.01	24
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	0	151	9	$4.09	95%	25%	-$0.01	23
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	645	4	$195.00	95%	74%	$0.08	27
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	645	4	$195.00	95%	74%	$0.08	17
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	645	4	$195.00	95%	74%	$0.08	28
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	645	4	$195.00	95%	74%	$0.08	8
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	129	4	$39.00	95%	83%	$0.07	41
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	129	4	$39.00	95%	83%	$0.07	26
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	129	4	$39.00	95%	83%	$0.07	42
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	129	4	$39.00	95%	83%	$0.07	12
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	645	4	$195.00	95%	93%	$0.08	85
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	645	4	$195.00	95%	93%	$0.08	54
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	645	4	$195.00	95%	93%	$0.08	87
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	645	4	$195.00	95%	93%	$0.08	25
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	430	4	$130.00	95%	93%	$0.07	1,193

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	430	4	$130.00	95%	93%	$0.07	759
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	430	4	$130.00	95%	93%	$0.07	1,228
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	430	4	$130.00	95%	93%	$0.07	355
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	817	4	$247.00	95%	46%	$0.08	271
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	817	4	$247.00	95%	46%	$0.08	172
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	817	4	$247.00	95%	46%	$0.08	278
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	817	4	$247.00	95%	46%	$0.08	81
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	774	4	$234.00	95%	65%	$0.08	80
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	774	4	$234.00	95%	65%	$0.08	51
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	774	4	$234.00	95%	65%	$0.08	82
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	774	4	$234.00	95%	65%	$0.08	24
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	774	4	$234.00	95%	65%	$0.08	29
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	774	4	$234.00	95%	65%	$0.08	19
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	0	774	4	$234.00	95%	65%	$0.08	30
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	0	774	4	$234.00	95%	65%	$0.08	9
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	57	10	$51.48	95%	35%	$0.12	8
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	120	10	$51.48	95%	35%	$0.05	17
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	1642	10	$1,059.80	95%	35%	$0.09	82
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	3418	10	$1,059.80	95%	35%	$0.03	176
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	10	10	$11.74	95%	35%	$0.17	18
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	20	10	$11.74	95%	35%	$0.07	39
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	8	10	$9.08	95%	35%	$0.17	8
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	16	10	$9.08	95%	35%	$0.07	17
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	263	10	$289.28	95%	35%	$0.16	15
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	547	10	$289.28	95%	35%	$0.07	32
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	275	10	$302.80	95%	35%	$0.16	6
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	0	573	10	$302.80	95%	35%	$0.07	12
Electric	Energy Efficiency	Dry Goods Retail	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	434	15	$15.90	95%	76%	-$0.01	1,865
Electric	Energy Efficiency	Dry Goods Retail	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	353	15	$15.90	95%	76%	-$0.01	425

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Grocery	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	953	15	$44.24	95%	76%	-$0.01	202
Electric	Energy Efficiency	Grocery	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	1143	15	$44.24	95%	76%	-$0.01	81
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	1270	15	$23.50	95%	76%	-$0.01	1,611
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	991	15	$23.50	95%	76%	-$0.01	345
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	789	15	$24.20	95%	76%	-$0.01	430
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	492	15	$24.20	95%	76%	-$0.01	75
Electric	Energy Efficiency	Office	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	330	15	$10.72	95%	76%	-$0.01	2,897
Electric	Energy Efficiency	Office	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	278	15	$10.72	95%	76%	-$0.01	710
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	354	15	$16.59	95%	76%	-$0.01	2,390
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	292	15	$16.59	95%	76%	-$0.01	554
Electric	Energy Efficiency	Restaurant	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	174	15	$4.84	95%	76%	-$0.01	461
Electric	Energy Efficiency	Restaurant	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	138	15	$4.84	95%	76%	-$0.01	107
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	986	15	$36.98	95%	76%	-$0.01	751
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	664	15	$36.98	95%	76%	-$0.01	144
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	1032	15	$38.71	95%	76%	-$0.01	279
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	695	15	$38.71	95%	76%	-$0.01	53
Electric	Energy Efficiency	Warehouse	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	Existing	0	489	15	$83.65	95%	76%	$0.01	281
Electric	Energy Efficiency	Warehouse	Ventilation and Circulation	Retrofit	Motor - CEE Premium-Efficiency Plus	CEE PE+ Motor for HVAC Applications	NEMA Efficiency Motors	New	0	475	15	$83.65	95%	76%	$0.01	83
Electric	Energy Efficiency	Dry Goods Retail	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	7961	20	$2,127.84	65%	75%	$0.01	23,466
Electric	Energy Efficiency	Dry Goods Retail	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	6480	20	$2,127.84	65%	75%	$0.02	6,324
Electric	Energy Efficiency	Grocery	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	17484	20	$3,897.69	65%	75%	$0.01	2,807
Electric	Energy Efficiency	Grocery	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	20960	20	$3,897.69	65%	75%	$0.01	1,203
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	23299	20	$2,602.68	65%	75%	$0.00	20,072
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	18166	20	$2,602.68	65%	75%	$0.00	5,136
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	14474	20	$2,645.85	65%	75%	$0.01	5,409
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	9015	20	$2,645.85	65%	75%	$0.02	1,115
Electric	Energy Efficiency	Office	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	6055	20	$2,473.18	65%	75%	$0.03	37,238

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Office	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	5095	20	$2,473.18	65%	75%	$0.04	10,562
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	6497	20	$2,171.01	65%	75%	$0.02	30,149
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	5353	20	$2,171.01	65%	75%	$0.03	8,241
Electric	Energy Efficiency	Restaurant	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	3185	20	$1,437.17	65%	75%	$0.03	5,937
Electric	Energy Efficiency	Restaurant	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	2539	20	$1,437.17	65%	75%	$0.05	1,597
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	18075	20	$5,753.88	65%	75%	$0.02	9,522
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	12177	20	$5,753.88	65%	75%	$0.04	2,138
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	18920	20	$5,969.71	65%	75%	$0.02	3,523
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	12746	20	$5,969.71	65%	75%	$0.04	789
Electric	Energy Efficiency	Warehouse	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	Existing	0	8963	20	$6,358.22	65%	75%	$0.06	3,699
Electric	Energy Efficiency	Warehouse	Ventilation and Circulation	Retrofit	Motor - Pump & Fan System - Variable Speed Control	Pump And Fan System Optimization w/ VSD	No Pump And Fan System VSD Optimization	New	0	8713	20	$6,358.22	65%	75%	$0.07	1,234
Electric	Energy Efficiency	Dry Goods Retail	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	Existing	0	1639	15	$7,868.42	5%	77%	$0.59	288
Electric	Energy Efficiency	Dry Goods Retail	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	New	0	1334	15	$7,868.42	5%	77%	$0.73	87
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	Existing	0	4797	15	$11,631.58	8%	77%	$0.29	403
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	New	0	3740	15	$11,631.58	8%	77%	$0.38	110
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	Existing	0	2980	15	$11,973.68	5%	77%	$0.50	60
Electric	Energy Efficiency	Hotel Motel	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	New	0	1856	15	$11,973.68	5%	77%	$0.81	15
Electric	Energy Efficiency	Office	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	Existing	0	1247	15	$10,605.26	11%	77%	$1.06	956
Electric	Energy Efficiency	Office	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	New	0	1049	15	$10,605.26	11%	77%	$1.27	290
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	Existing	0	1338	15	$8,210.53	13%	77%	$0.76	1,012
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	New	0	1102	15	$8,210.53	13%	77%	$0.93	282
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	Existing	0	3721	15	$36,605.26	11%	77%	$1.23	266
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	New	0	2507	15	$36,605.26	11%	77%	$1.84	58
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	Existing	0	3895	15	$38,315.79	11%	77%	$1.23	89
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Motor - VAV Box High Efficiency (ECM)	ECM Motor	Standard Efficiency Motor	New	0	2624	15	$38,315.79	11%	77%	$1.84	21
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	844	15	$15,500.00	20%	75%	$2.33	181

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	2014	15	$15,500.00	20%	75%	$0.96	320
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	1033	15	$15,500.00	20%	75%	$1.90	113
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	985	15	$12,000.00	20%	75%	$1.54	122
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	1649	15	$12,000.00	20%	75%	$0.90	53
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	839	15	$12,000.00	20%	75%	$1.81	21
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	876	15	$53,500.00	20%	75%	$7.75	8
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	6197	15	$53,500.00	20%	75%	$1.07	52
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	858	15	$53,500.00	20%	75%	$7.91	8
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	917	15	$56,000.00	20%	75%	$7.75	1
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	6487	15	$56,000.00	20%	75%	$1.07	1
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	898	15	$56,000.00	20%	75%	$7.91	0
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	1380	15	$60,500.00	20%	75%	$5.56	12
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	3222	15	$60,500.00	20%	75%	$2.35	12
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Natural Ventilation	Natural Ventilation Design Reduction in Cooling	None - Standard Ventilation	New	0	1175	15	$60,500.00	20%	75%	$6.53	3
Electric	Energy Efficiency	Hospital	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	Existing	0	2204	5	$269.52	95%	30%	$0.02	1,000
Electric	Energy Efficiency	Hospital	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	New	0	2204	5	$269.52	95%	30%	$0.02	334
Electric	Energy Efficiency	Office	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	Existing	0	3638	5	$444.84	95%	30%	$0.02	13,745
Electric	Energy Efficiency	Office	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	New	0	3638	5	$444.84	95%	30%	$0.02	4,444
Electric	Energy Efficiency	Other Commercial	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	Existing	0	694	5	$84.88	95%	30%	$0.02	1,868
Electric	Energy Efficiency	Other Commercial	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	New	0	694	5	$84.88	95%	30%	$0.02	648
Electric	Energy Efficiency	School	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	Existing	0	10151	5	$1,241.36	95%	30%	$0.02	2,799
Electric	Energy Efficiency	School	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	New	0	10151	5	$1,241.36	95%	30%	$0.02	902
Electric	Energy Efficiency	University	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	Existing	0	10626	5	$1,299.37	95%	30%	$0.02	1,069
Electric	Energy Efficiency	University	Computers	Retrofit	Network PC Power Management	Network PC Power Management	No Power Management	New	0	10626	5	$1,299.37	95%	30%	$0.02	343
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	Existing	0	20822	5	$3,123.32	95%	85%	$0.02	7,064
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	New	0	19842	5	$2,976.27	95%	85%	$0.02	2,184

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	Existing	0	271	5	$40.68	15%	85%	$0.02	67
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	New	0	331	5	$49.72	15%	85%	$0.02	27
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	Existing	0	77	5	$11.49	5%	85%	$0.02	39
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	New	0	94	5	$14.04	5%	85%	$0.02	15
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	Existing	0	614	5	$92.13	30%	85%	$0.02	704
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	New	0	751	5	$112.60	30%	85%	$0.02	279
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	Existing	0	853	5	$128.02	50%	85%	$0.02	410
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	New	0	853	5	$128.02	50%	85%	$0.02	133
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	Existing	0	893	5	$134.01	50%	85%	$0.02	156
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Night Covers for Display Cases	Night Covers for Display Cases	No Night Covers	New	0	893	5	$134.01	50%	85%	$0.02	51
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	1162	8	$979.63	45%	75%	$0.14	2,408
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	1162	8	$979.63	45%	75%	$0.14	864
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	4773	8	$979.63	45%	56%	$0.02	7,354
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	28	8	$979.63	45%	56%	$6.36	1,075
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	6411	8	$979.63	45%	56%	$0.01	2,777
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	1682	8	$979.63	45%	56%	$0.09	795
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	3058	8	$2,725.93	45%	75%	$0.15	301
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	3058	8	$2,725.93	45%	75%	$0.15	135
Electric	Energy Efficiency	Grocery	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	20197	8	$2,725.93	45%	57%	$0.01	1,653
Electric	Energy Efficiency	Grocery	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	92	8	$2,725.93	45%	57%	$5.34	188
Electric	Energy Efficiency	Grocery	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	22026	8	$2,725.93	45%	57%	$0.01	580
Electric	Energy Efficiency	Grocery	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	3236	8	$2,725.93	45%	57%	$0.14	95
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	794	8	$1,448.15	90%	75%	$0.31	832
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	794	8	$1,448.15	90%	75%	$0.31	310
Electric	Energy Efficiency	Hospital	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	5631	8	$1,448.15	90%	42%	$0.03	3,553
Electric	Energy Efficiency	Hospital	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	4	8	$1,448.15	90%	42%	$60.85	38
Electric	Energy Efficiency	Hospital	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	5787	8	$1,448.15	90%	42%	$0.03	1,026
Electric	Energy Efficiency	Hospital	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	2281	8	$1,448.15	90%	42%	$0.10	533
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	1819	8	$1,490.75	90%	75%	$0.13	939

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	1819	8	$1,490.75	90%	75%	$0.13	327
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	4126	8	$1,490.75	90%	58%	$0.05	1,630
Electric	Energy Efficiency	Hotel Motel	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	5	8	$1,490.75	90%	58%	$53.29	37
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	11430	8	$1,490.75	90%	58%	$0.01	1,272
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	15041	8	$1,490.75	90%	58%	$0.00	2,102
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	609	8	$1,320.37	90%	75%	$0.37	4,994
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	609	8	$1,320.37	90%	75%	$0.37	1,881
Electric	Energy Efficiency	Office	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	4676	8	$1,320.37	90%	42%	$0.03	23,316
Electric	Energy Efficiency	Office	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	6	8	$1,320.37	90%	42%	$39.17	602
Electric	Energy Efficiency	Office	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	4619	8	$1,320.37	90%	42%	$0.03	6,530
Electric	Energy Efficiency	Office	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	794	8	$1,320.37	90%	42%	$0.28	1,183
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	1343	8	$1,022.22	90%	75%	$0.12	9,854
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	1343	8	$1,022.22	90%	75%	$0.12	3,365
Electric	Energy Efficiency	Other Commercial	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	2398	8	$1,022.22	90%	52%	$0.06	11,586
Electric	Energy Efficiency	Other Commercial	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	28	8	$1,022.22	90%	52%	$6.56	3,531
Electric	Energy Efficiency	Other Commercial	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	3484	8	$1,022.22	90%	52%	$0.04	4,727
Electric	Energy Efficiency	Other Commercial	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	750	8	$1,022.22	90%	52%	$0.23	1,143
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	752	8	$298.15	45%	75%	$0.06	1,016
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	752	8	$298.15	45%	75%	$0.06	367
Electric	Energy Efficiency	Restaurant	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	1080	8	$298.15	45%	64%	$0.04	1,005
Electric	Energy Efficiency	Restaurant	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	3	8	$298.15	45%	64%	$21.14	41
Electric	Energy Efficiency	Restaurant	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	1846	8	$298.15	45%	64%	$0.01	579
Electric	Energy Efficiency	Restaurant	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	1486	8	$298.15	45%	64%	$0.02	576
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	2562	8	$4,557.42	90%	75%	$0.31	1,710
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	2562	8	$4,557.42	90%	75%	$0.31	598
Electric	Energy Efficiency	School	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	10211	8	$4,557.42	90%	35%	$0.07	2,909
Electric	Energy Efficiency	School	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	32	8	$4,557.42	90%	35%	$25.40	228
Electric	Energy Efficiency	School	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	9732	8	$4,557.42	90%	35%	$0.07	837
Electric	Energy Efficiency	School	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	541	8	$4,557.42	90%	35%	$1.51	42

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	2681	8	$4,770.38	90%	75%	$0.31	660
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	2681	8	$4,770.38	90%	75%	$0.31	228
Electric	Energy Efficiency	University	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	8322	8	$4,770.38	90%	35%	$0.09	851
Electric	Energy Efficiency	University	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	23	8	$4,770.38	90%	35%	$38.17	55
Electric	Energy Efficiency	University	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	10467	8	$4,770.38	90%	35%	$0.07	327
Electric	Energy Efficiency	University	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	3111	8	$4,770.38	90%	35%	$0.26	144
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	1838	8	$5,153.71	90%	75%	$0.49	1,641
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	1838	8	$5,153.71	90%	75%	$0.49	591
Electric	Energy Efficiency	Warehouse	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	7331	8	$5,153.71	90%	50%	$0.11	4,954
Electric	Energy Efficiency	Warehouse	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	203	8	$5,153.71	90%	50%	$4.56	3,618
Electric	Energy Efficiency	Warehouse	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	12443	8	$5,153.71	90%	50%	$0.06	2,341
Electric	Energy Efficiency	Warehouse	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	3602	8	$5,153.71	90%	50%	$0.24	813
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Optimized Variable Volume Lab Hood Design	Optimized Variable Volume Lab Hood Design	Constant Volume Lab Hood Design	Existing	0	2284	13	$3,050.87	65%	59%	$0.17	1,590
Electric	Energy Efficiency	Hospital	Ventilation and Circulation	Retrofit	Optimized Variable Volume Lab Hood Design	Optimized Variable Volume Lab Hood Design	Constant Volume Lab Hood Design	New	0	1781	13	$3,050.87	65%	59%	$0.22	402
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Optimized Variable Volume Lab Hood Design	Optimized Variable Volume Lab Hood Design	Constant Volume Lab Hood Design	Existing	0	637	13	$3,050.87	5%	59%	$0.64	186
Electric	Energy Efficiency	Other Commercial	Ventilation and Circulation	Retrofit	Optimized Variable Volume Lab Hood Design	Optimized Variable Volume Lab Hood Design	Constant Volume Lab Hood Design	New	0	525	13	$3,050.87	5%	59%	$0.78	50
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Optimized Variable Volume Lab Hood Design	Optimized Variable Volume Lab Hood Design	Constant Volume Lab Hood Design	Existing	0	1772	13	$3,050.87	65%	59%	$0.22	766
Electric	Energy Efficiency	School	Ventilation and Circulation	Retrofit	Optimized Variable Volume Lab Hood Design	Optimized Variable Volume Lab Hood Design	Constant Volume Lab Hood Design	New	0	1194	13	$3,050.87	65%	59%	$0.33	167
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Optimized Variable Volume Lab Hood Design	Optimized Variable Volume Lab Hood Design	Constant Volume Lab Hood Design	Existing	0	1855	13	$3,050.87	65%	59%	$0.21	283
Electric	Energy Efficiency	University	Ventilation and Circulation	Retrofit	Optimized Variable Volume Lab Hood Design	Optimized Variable Volume Lab Hood Design	Constant Volume Lab Hood Design	New	0	1250	13	$3,050.87	65%	59%	$0.32	62
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Pipe Insulation - Chilled Water	1.5" of Insulation, assuming R-6 (WA State Code)	No Insulation	Existing	0	854	15	$119.85	65%	45%	$0.01	76
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Pipe Insulation - Chilled Water	1.5" of Insulation, assuming R-6 (WA State Code)	No Insulation	Existing	0	773	15	$123.38	65%	45%	$0.01	33
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Pipe Insulation - Chilled Water	1.5" of Insulation, assuming R-6 (WA State Code)	No Insulation	Existing	0	875	15	$109.28	65%	45%	$0.01	627
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Pipe Insulation - Chilled Water	1.5" of Insulation, assuming R-6 (WA State Code)	No Insulation	Existing	0	576	15	$84.60	65%	45%	$0.01	93
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Pipe Insulation - Chilled Water	1.5" of Insulation, assuming R-6 (WA State Code)	No Insulation	Existing	0	524	15	$377.18	65%	45%	$0.09	29
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Pipe Insulation - Chilled Water	1.5" of Insulation, assuming R-6 (WA State Code)	No Insulation	Existing	0	549	15	$394.80	65%	45%	$0.09	1

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Pipe Insulation - Chilled Water	1.5" of Insulation, assuming R-6 (WA State Code)	No Insulation	Existing	0	297	15	$426.53	65%	45%	$0.18	4
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	33	12	$25.44	80%	90%	$0.09	49
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	31	12	$25.44	80%	90%	$0.10	47
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	97	12	$101.76	80%	90%	$0.14	4
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	91	12	$101.76	80%	90%	$0.15	4
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	240	12	$147.55	80%	70%	$0.07	53
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	225	12	$147.55	80%	70%	$0.08	50
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	305	12	$139.92	80%	90%	$0.05	32
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	286	12	$139.92	80%	90%	$0.05	26
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	73	12	$25.44	80%	30%	$0.03	95
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	68	12	$25.44	80%	30%	$0.04	92
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	46	12	$27.99	80%	90%	$0.07	100
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	43	12	$27.99	80%	90%	$0.08	97
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	310	12	$25.44	80%	90%	$0.00	163
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	290	12	$25.44	80%	90%	$0.00	157
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	808	12	$96.67	80%	8%	$0.00	8
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	758	12	$96.67	80%	8%	$0.01	8
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	845	12	$101.76	80%	8%	$0.00	3
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	793	12	$101.76	80%	8%	$0.01	3
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	121	12	$25.44	80%	90%	$0.01	52
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	0	113	12	$25.44	80%	90%	$0.01	51
Electric	Energy Efficiency	Dry Goods Retail	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	22	4	$1.73	95%	86%	$0.01	129
Electric	Energy Efficiency	Dry Goods Retail	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	22	4	$1.73	95%	86%	$0.01	42
Electric	Energy Efficiency	Grocery	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	95	4	$4.80	95%	86%	$0.00	32

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Grocery	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	95	4	$4.80	95%	86%	$0.00	11
Electric	Energy Efficiency	Hospital	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	180	4	$2.55	95%	86%	-$0.01	283
Electric	Energy Efficiency	Hospital	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	180	4	$2.55	95%	86%	-$0.01	92
Electric	Energy Efficiency	Hotel Motel	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	41	4	$2.63	95%	86%	$0.00	29
Electric	Energy Efficiency	Hotel Motel	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	41	4	$2.63	95%	86%	$0.00	9
Electric	Energy Efficiency	Office	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	18	4	$2.33	95%	86%	$0.02	225
Electric	Energy Efficiency	Office	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	18	4	$2.33	95%	86%	$0.02	73
Electric	Energy Efficiency	Other Commercial	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	21	4	$1.80	95%	86%	$0.01	200
Electric	Energy Efficiency	Other Commercial	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	21	4	$1.80	95%	86%	$0.01	65
Electric	Energy Efficiency	Restaurant	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	13	4	$0.53	95%	86%	$0.00	49
Electric	Energy Efficiency	Restaurant	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	13	4	$0.53	95%	86%	$0.00	16
Electric	Energy Efficiency	School	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	3	4	$8.03	95%	86%	$0.73	3
Electric	Energy Efficiency	School	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	3	4	$8.03	95%	86%	$0.73	1
Electric	Energy Efficiency	University	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	3	4	$8.40	95%	86%	$0.73	1
Electric	Energy Efficiency	University	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	3	4	$8.40	95%	86%	$0.73	0
Electric	Energy Efficiency	Warehouse	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	Existing	0	46	4	$9.08	95%	86%	$0.04	65
Electric	Energy Efficiency	Warehouse	Other Plug Load	Retrofit	Power Supply Transformer/Converter	80 Plus	85% efficient power supply (> 51W)	New	0	46	4	$9.08	95%	86%	$0.04	21
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1085	10	$351.92	95%	26%	-$0.04	790
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	536	10	$351.92	95%	13%	$0.01	67
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1668	10	$351.92	95%	26%	$0.01	233
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	822	10	$351.92	95%	13%	$0.05	19
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	2749	10	$339.91	95%	31%	-$0.20	174
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	2306	10	$339.91	95%	15%	-$0.03	25
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	7311	10	$339.91	95%	31%	-$0.01	98
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	2642	10	$339.91	95%	15%	$0.00	6
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1607	10	$476.65	95%	24%	-$0.33	304
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	419	10	$476.65	95%	12%	-$1.20	14

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	3084	10	$476.65	95%	24%	$0.01	69
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	1310	10	$476.65	95%	12%	$0.04	4
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1617	10	$476.65	95%	26%	-$0.02	121
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	357	10	$476.65	95%	26%	$0.03	9
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1464	10	$790.29	95%	31%	-$0.06	53
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	465	10	$790.29	95%	15%	-$0.02	3
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	3325	10	$790.29	95%	31%	$0.02	194
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	1696	10	$790.29	95%	15%	$0.05	15
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1464	10	$790.29	95%	26%	-$0.14	59
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	396	10	$790.29	95%	26%	-$0.25	6
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1185	10	$523.76	95%	26%	-$0.19	1,560
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	422	10	$523.76	95%	13%	-$0.11	96
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	2326	10	$523.76	95%	26%	$0.01	2,034
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	1007	10	$523.76	95%	13%	$0.06	138
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1656	10	$523.76	95%	26%	-$0.06	1,006
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	516	10	$523.76	95%	26%	$0.04	106
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1107	10	$351.68	95%	28%	-$0.09	912
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	493	10	$351.68	95%	14%	-$0.03	70
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1806	10	$351.68	95%	28%	$0.01	431
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	824	10	$351.68	95%	14%	$0.05	25
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1091	10	$351.68	95%	26%	-$0.07	149
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	420	10	$351.68	95%	26%	$0.01	20
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	720	10	$364.60	95%	25%	$0.05	347

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	270	10	$364.60	95%	13%	$0.16	20
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	853	10	$364.60	95%	25%	$0.05	96
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	338	10	$364.60	95%	13%	$0.16	5
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	910	10	$330.32	95%	21%	-$0.84	37
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	438	10	$330.32	95%	10%	-$1.08	3
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	7210	10	$330.32	95%	21%	-$0.02	335
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	3099	10	$330.32	95%	10%	-$0.01	22
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	992	10	$330.32	95%	26%	-$0.73	48
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	429	10	$330.32	95%	26%	-$1.40	7
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	952	10	$741.08	95%	21%	-$1.01	3
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	458	10	$741.08	95%	10%	-$0.92	0
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	7547	10	$741.08	95%	21%	-$0.01	7
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	3244	10	$741.08	95%	10%	$0.01	0
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1039	10	$741.08	95%	26%	-$1.34	2
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	449	10	$741.08	95%	26%	-$2.58	0
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	571	10	$327.24	95%	24%	-$0.29	27
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	690	10	$327.24	95%	12%	-$0.09	6
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	2207	10	$327.24	95%	24%	-$0.01	40
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	1611	10	$327.24	95%	12%	$0.00	5
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	563	10	$327.24	95%	26%	-$0.27	7
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	587	10	$327.24	95%	26%	-$0.03	3
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	123	30	$1,167.25	75%	55%	$0.99	93
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	61	30	$1,772.82	75%	55%	$3.07	20
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	1460	30	$1,167.25	75%	55%	$0.06	338

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	719	30	$1,772.82	75%	55%	$0.24	52
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	112	30	$4,794.58	75%	55%	$4.51	6
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	94	30	$2,049.44	75%	55%	$2.29	2
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	2301	30	$4,794.58	75%	55%	$0.21	33
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	832	30	$2,049.44	75%	55%	$0.25	4
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	124	30	$3,274.93	75%	55%	$2.79	26
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	32	30	$2,200.69	75%	55%	$7.21	3
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	1827	30	$3,274.93	75%	55%	$0.17	71
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	776	30	$2,200.69	75%	55%	$0.28	9
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	834	30	$3,274.93	75%	55%	$0.41	85
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	184	30	$2,200.69	75%	55%	$1.26	7
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	109	30	$5,122.56	75%	55%	$4.95	4
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	35	30	$1,167.25	75%	55%	$3.55	0
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	1914	30	$5,122.56	75%	55%	$0.27	125
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	976	30	$1,167.25	75%	55%	$0.11	25
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	733	30	$5,122.56	75%	55%	$0.73	38
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	198	30	$1,167.25	75%	55%	$0.61	4
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	100	30	$2,153.60	75%	55%	$2.27	132
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	36	30	$4,794.58	75%	55%	$14.24	21
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	1511	30	$2,153.60	75%	55%	$0.13	2,047
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	654	30	$4,794.58	75%	55%	$0.75	291
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	936	30	$2,153.60	75%	55%	$0.23	726
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	292	30	$4,794.58	75%	55%	$1.73	89
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	121	30	$3,655.40	75%	55%	$3.20	91
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	54	30	$2,249.92	75%	55%	$4.43	18
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	1515	30	$3,655.40	75%	55%	$0.24	480
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	692	30	$2,249.92	75%	55%	$0.32	62
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	797	30	$3,655.40	75%	55%	$0.48	140
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	306	30	$2,249.92	75%	55%	$0.77	22

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	269	30	$3,274.93	75%	55%	$1.28	134
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	101	30	$2,249.92	75%	55%	$2.35	18
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	2455	30	$3,274.93	75%	55%	$0.13	459
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	973	30	$2,249.92	75%	55%	$0.23	49
Electric	Energy Efficiency	School	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	22	30	$3,655.40	75%	55%	$17.38	1
Electric	Energy Efficiency	School	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	11	30	$3,274.93	75%	55%	$32.36	0
Electric	Energy Efficiency	School	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	1357	30	$3,655.40	75%	55%	$0.26	109
Electric	Energy Efficiency	School	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	583	30	$3,274.93	75%	55%	$0.56	14
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	162	30	$3,655.40	75%	55%	$2.38	11
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	70	30	$3,274.93	75%	55%	$4.93	2
Electric	Energy Efficiency	University	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	22	30	$2,249.92	75%	55%	$10.69	0
Electric	Energy Efficiency	University	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	11	30	$5,122.56	75%	55%	$50.61	0
Electric	Energy Efficiency	University	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	1357	30	$2,249.92	75%	55%	$0.15	2
Electric	Energy Efficiency	University	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	583	30	$5,122.56	75%	55%	$0.90	0
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	162	30	$2,249.92	75%	55%	$1.46	1
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	70	30	$5,122.56	75%	55%	$7.71	0
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	12	30	$2,049.44	75%	55%	$17.57	1
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	15	30	$2,200.69	75%	55%	$15.60	0
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	367	30	$2,049.44	75%	55%	$0.56	12
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	268	30	$2,200.69	75%	55%	$0.83	3
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	Existing	0	82	30	$2,049.44	75%	55%	$2.65	2
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	RE - Deciduous Trees	Shade Trees	No Trees	New	0	85	30	$2,200.69	75%	55%	$2.73	1
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	2431	30	$3,566.04	10%	95%	$0.14	41
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	3172	30	$9,922.89	10%	95%	$0.32	3
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	1300	30	$5,271.54	10%	95%	$0.41	3
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	2315	30	$5,426.58	10%	95%	$0.23	13
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	5801	30	$4,806.40	10%	95%	$0.07	642
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	332	30	$3,721.09	10%	95%	$1.17	7
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	923	30	$1,085.31	10%	95%	$0.11	15

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	School	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	2410	30	$16,589.84	10%	95%	$0.70	13
Electric	Energy Efficiency	University	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	3044	30	$17,365.07	10%	95%	$0.57	0
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	368	30	$18,760.47	10%	95%	$5.36	1
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	202	30	$184.53	75%	75%	$0.09	117
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	310	30	$184.53	75%	75%	$0.04	33
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	245	30	$184.53	75%	75%	$0.07	10
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	281	30	$184.53	75%	75%	$0.05	2
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	210	30	$184.53	75%	75%	$0.08	34
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	655	30	$184.53	75%	75%	$0.01	13
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	179	30	$184.53	75%	75%	$0.10	11
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	890	30	$184.53	75%	75%	$0.02	21
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	3248	30	$184.53	75%	75%	-$0.01	120
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	758	30	$184.53	75%	75%	$0.02	24
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	265	30	$184.53	75%	75%	$0.07	275
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	632	30	$184.53	75%	75%	$0.01	421
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	324	30	$184.53	75%	75%	$0.05	156
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	394	30	$184.53	75%	75%	$0.04	233
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	659	30	$184.53	75%	75%	$0.01	110
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	336	30	$184.53	75%	75%	$0.05	36
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	126	30	$184.53	75%	75%	$0.15	49
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	158	30	$184.53	75%	75%	$0.11	15
Electric	Energy Efficiency	School	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	745	30	$184.53	75%	75%	$0.02	31
Electric	Energy Efficiency	School	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	5273	30	$184.53	75%	75%	-$0.03	230
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	730	30	$184.53	75%	75%	$0.02	28
Electric	Energy Efficiency	University	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	780	30	$184.53	75%	75%	$0.02	3
Electric	Energy Efficiency	University	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	5519	30	$184.53	75%	75%	-$0.03	5
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	764	30	$184.53	75%	75%	$0.02	1
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	671	30	$184.53	75%	75%	$0.02	28
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	1567	30	$184.53	75%	75%	-$0.02	23

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	RE - Window Overhangs	Overhangs over windows for shading	No window overhangs	New	0	571	30	$184.53	75%	75%	$0.03	6
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	3255	7	$3,105.00	90%	85%	$0.10	6,871
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	5004	7	$3,105.00	90%	85%	$0.10	1,886
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	8247	7	$8,640.00	90%	85%	-$0.02	1,256
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	21933	7	$8,640.00	90%	85%	$0.06	578
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	4822	7	$4,590.00	90%	85%	-$0.19	2,984
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	9251	7	$4,590.00	90%	85%	$0.08	579
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	4852	7	$4,590.00	90%	85%	$0.13	1,026
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	4392	7	$4,725.00	90%	85%	$0.07	369
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	9976	7	$4,725.00	90%	85%	$0.08	1,343
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	4393	7	$4,725.00	90%	85%	-$0.01	537
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	3555	7	$4,185.00	90%	85%	-$0.02	13,946
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	6977	7	$4,185.00	90%	85%	$0.10	16,049
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	4968	7	$4,185.00	90%	85%	$0.06	7,983
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	3321	7	$3,240.00	90%	85%	$0.05	6,939
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	5417	7	$3,240.00	90%	85%	$0.10	2,931
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	3274	7	$3,240.00	90%	85%	$0.08	1,170
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	2161	7	$945.00	90%	85%	$0.05	3,173
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	2560	7	$945.00	90%	85%	$0.06	767
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	2729	7	$14,445.00	90%	85%	$0.16	330
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	21629	7	$14,445.00	90%	85%	$0.10	3,139
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	2976	7	$14,445.00	90%	85%	$0.18	401
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	2857	7	$15,120.00	90%	85%	-$0.09	3

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	22640	7	$15,120.00	90%	85%	$0.10	43
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	3116	7	$15,120.00	90%	85%	-$0.49	13
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	1712	7	$16,335.00	90%	85%	$1.51	171
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	6621	7	$16,335.00	90%	85%	$0.45	302
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	1690	7	$16,335.00	90%	85%	$1.56	35
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	Existing	0	52214	3	$4,102.53	95%	85%	$0.02	13,924
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	New	0	26107	3	$4,102.53	80%	90%	$0.05	2,236
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	Existing	0	605	3	$47.51	10%	85%	$0.02	76
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	New	0	302	3	$47.51	5%	90%	$0.05	7
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	Existing	0	112	3	$8.77	5%	85%	$0.02	5
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	New	0	56	3	$8.77	5%	90%	$0.05	6
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	Existing	0	1508	3	$118.48	10%	85%	$0.02	444
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	New	0	754	3	$118.48	5%	90%	$0.05	43
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	Existing	0	1790	3	$140.66	10%	85%	$0.02	130
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	New	0	895	3	$140.66	5%	90%	$0.05	12
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	Existing	0	1874	3	$147.23	10%	85%	$0.02	50
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Refrigeration Commissioning of New and Existing Buildings	New and Existing Building Refrigeration Commissioning	No Commissioning	New	0	937	3	$147.23	5%	90%	$0.05	5
Electric	Energy Efficiency	Dry Goods Retail	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	152	5	$44.40	25%	100%	$0.06	225
Electric	Energy Efficiency	Grocery	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	1427	5	$415.78	25%	100%	$0.06	125
Electric	Energy Efficiency	Hospital	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	1469	5	$427.77	25%	100%	$0.06	592
Electric	Energy Efficiency	Hotel Motel	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	2833	5	$825.25	25%	100%	$0.06	520
Electric	Energy Efficiency	Office	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	571	5	$166.30	25%	100%	$0.06	1,852
Electric	Energy Efficiency	Other Commercial	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	455	5	$132.68	25%	100%	$0.06	1,129

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	134	5	$39.10	25%	100%	$0.06	126
Electric	Energy Efficiency	School	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	1840	5	$536.12	25%	100%	$0.06	434
Electric	Energy Efficiency	University	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	1927	5	$561.17	25%	100%	$0.06	165
Electric	Energy Efficiency	Warehouse	Refrigerator	Retrofit	Residential Refrigerator/Freezer Recycling	Recycling Existing Refrigerator/Freezer	Existing Refrigerator/Freezer	Existing	0	715	5	$208.32	25%	100%	$0.06	257
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	Existing	0	7321	10	$41,197.06	25%	98%	$0.87	209
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	New	0	1979	10	$41,197.06	75%	98%	$3.24	59
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	Existing	0	8281	10	$36,488.82	25%	98%	$0.68	3,263
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	New	0	2582	10	$36,488.82	75%	98%	$2.19	1,129
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	Existing	0	5456	10	$28,249.41	25%	98%	$0.80	495
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	New	0	2098	10	$28,249.41	75%	98%	$2.09	209
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	Existing	0	4961	10	$125,945.30	25%	98%	$3.95	172
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	New	0	2145	10	$125,945.30	75%	98%	$9.15	80
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	Existing	0	5193	10	$131,830.60	25%	98%	$3.95	9
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	New	0	2245	10	$131,830.60	75%	98%	$9.15	4

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	Existing	0	2816	10	$142,424.12	25%	98%	$7.88	23
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 50% sensible and latent recovery effectiveness	No Heat Recovery	New	0	2937	10	$142,424.12	75%	98%	$7.56	27
Electric	Energy Efficiency	Hospital	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	Existing	0	360	4	$304.00	72%	85%	-$1.72	339
Electric	Energy Efficiency	Hospital	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	New	0	360	4	$304.00	72%	85%	-$1.72	108
Electric	Energy Efficiency	Office	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	Existing	0	360	4	$304.00	72%	85%	-$1.72	2,727
Electric	Energy Efficiency	Office	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	New	0	360	4	$304.00	72%	85%	-$1.72	866
Electric	Energy Efficiency	Other Commercial	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	Existing	0	360	4	$304.00	72%	85%	-$1.72	2,083
Electric	Energy Efficiency	Other Commercial	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	New	0	360	4	$304.00	72%	85%	-$1.72	661
Electric	Energy Efficiency	School	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	Existing	0	360	4	$304.00	72%	85%	-$1.72	198
Electric	Energy Efficiency	School	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	New	0	360	4	$304.00	72%	85%	-$1.72	63
Electric	Energy Efficiency	University	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	Existing	0	360	4	$304.00	72%	85%	-$1.72	72
Electric	Energy Efficiency	University	Servers	Retrofit	Server Virtualization	Server Virtualization	No Virtualization	New	0	360	4	$304.00	72%	85%	-$1.72	23
Electric	Energy Efficiency	Dry Goods Retail	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	230	4	$58.46	60%	90%	$0.06	880
Electric	Energy Efficiency	Dry Goods Retail	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	230	4	$58.46	60%	90%	$0.06	286
Electric	Energy Efficiency	Grocery	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	640	4	$162.67	60%	90%	$0.06	145
Electric	Energy Efficiency	Grocery	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	640	4	$162.67	60%	90%	$0.06	47
Electric	Energy Efficiency	Hospital	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	567	4	$144.03	60%	90%	$0.06	592
Electric	Energy Efficiency	Hospital	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	567	4	$144.03	60%	90%	$0.06	192
Electric	Energy Efficiency	Hotel Motel	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	438	4	$111.20	60%	90%	$0.06	208
Electric	Energy Efficiency	Hotel Motel	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	438	4	$111.20	60%	90%	$0.06	67
Electric	Energy Efficiency	Office	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	1033	4	$262.65	60%	90%	$0.06	8,684
Electric	Energy Efficiency	Office	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	1033	4	$262.65	60%	90%	$0.06	2,817
Electric	Energy Efficiency	Other Commercial	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	240	4	$61.00	60%	90%	$0.06	1,541
Electric	Energy Efficiency	Other Commercial	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	240	4	$61.00	60%	90%	$0.06	500
Electric	Energy Efficiency	Restaurant	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	70	4	$17.79	60%	90%	$0.06	170
Electric	Energy Efficiency	Restaurant	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	70	4	$17.79	60%	90%	$0.06	55

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	School	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	535	4	$135.99	60%	90%	$0.06	327
Electric	Energy Efficiency	School	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	535	4	$135.99	60%	90%	$0.06	106
Electric	Energy Efficiency	University	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	560	4	$142.34	60%	90%	$0.06	124
Electric	Energy Efficiency	University	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	560	4	$142.34	60%	90%	$0.06	40
Electric	Energy Efficiency	Warehouse	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	Existing	0	403	4	$102.52	60%	90%	$0.06	376
Electric	Energy Efficiency	Warehouse	Other Plug Load	Retrofit	Advanced Power Strip	Advanced Power Strip - Load Sensing	Standard Power Strip	New	0	403	4	$102.52	60%	90%	$0.06	122
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	Existing	0	12	12	-$111.83	95%	81%	-$1.30	4
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	New	0	12	12	-$111.83	95%	81%	-$1.30	1
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	Existing	0	10	12	-$115.05	95%	81%	-$1.71	14
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	New	0	10	12	-$115.05	95%	81%	-$1.71	5
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	Existing	0	4	12	-$35.69	95%	81%	-$1.20	39
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	New	0	4	12	-$35.69	95%	81%	-$1.20	13
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	Existing	0	1	12	-$10.52	95%	81%	-$1.71	3
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	New	0	1	12	-$10.52	95%	81%	-$1.71	1
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	Existing	0	12	12	-$144.19	95%	81%	-$1.71	11
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	New	0	12	12	-$144.19	95%	81%	-$1.71	3
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	Existing	0	13	12	-$150.93	95%	81%	-$1.71	4
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Solid Door ENERGY STAR Refrigerators/Freezers	Solid Door ENERGY STAR Refrigerators/Freezers	Standard Solid Door	New	0	13	12	-$150.93	95%	81%	-$1.71	1
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	399	14	$79.92	5%	95%	$0.01	134
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	399	14	$79.92	5%	95%	$0.01	44
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	1110	14	$222.40	5%	95%	$0.01	22
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	1110	14	$222.40	5%	95%	$0.01	7
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	982	14	$196.92	5%	95%	$0.01	90

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Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	982	14	$196.92	5%	95%	$0.01	29
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	759	14	$152.04	5%	95%	$0.01	32
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	759	14	$152.04	5%	95%	$0.01	10
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	1792	14	$359.08	5%	95%	$0.01	1,324
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	1792	14	$359.08	5%	95%	$0.01	430
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	416	14	$83.40	5%	95%	$0.01	235
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	416	14	$83.40	5%	95%	$0.01	76
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	121	14	$24.32	5%	95%	$0.01	26
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	121	14	$24.32	5%	95%	$0.01	8
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	928	14	$185.91	5%	95%	$0.01	50
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	928	14	$185.91	5%	95%	$0.01	16
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	971	14	$194.60	5%	95%	$0.01	19
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	971	14	$194.60	5%	95%	$0.01	6
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	Existing	0	699	14	$140.15	5%	95%	$0.01	57
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Solid State LED White Lighting	Landscape, merchandise, signage, structure & task lighting (2.5 W)	50W 10hrs/day, 365 day/yr	New	0	699	14	$140.15	5%	95%	$0.01	19
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Standalone to Multiplex Compressor	Standalone to Multiplex Compressor	Standalone compressor	Existing	0	19675	15	$2,810.73	80%	90%	$0.00	5,553
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Standalone to Multiplex Compressor	Standalone to Multiplex Compressor	Standalone compressor	Existing	0	42	15	$1,054.02	3%	90%	$3.17	5
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	0	4817	9	$54.45	5%	62%	-$0.01	20
Electric	Energy Efficiency	Grocery	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	0	4817	9	$54.45	5%	62%	-$0.01	11

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	0	974	9	$11.02	5%	62%	-$0.01	6
Electric	Energy Efficiency	Hospital	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	0	974	9	$11.02	5%	62%	-$0.01	6
Electric	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	0	1173	9	$13.26	3%	62%	-$0.01	0
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	0	704	9	$7.95	5%	62%	-$0.01	102
Electric	Energy Efficiency	Other Commercial	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	0	704	9	$7.95	5%	62%	-$0.01	45
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	0	16996	9	$192.12	20%	62%	-$0.01	1,656
Electric	Energy Efficiency	Restaurant	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	0	16996	9	$192.12	20%	62%	-$0.01	541
Electric	Energy Efficiency	School	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	0	397	9	$4.49	5%	62%	-$0.01	2
Electric	Energy Efficiency	University	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	0	758	9	$8.57	5%	62%	-$0.01	1
Electric	Energy Efficiency	University	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	0	758	9	$8.57	5%	62%	-$0.01	2
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Strip Curtains for Walk-Ins	Strip Curtains for Walk-Ins	No Strip Curtains for Walk-In	Existing	0	820	4	$26.75	95%	20%	$0.00	59
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Strip Curtains for Walk-Ins	Strip Curtains for Walk-Ins	No Strip Curtains for Walk-In	Existing	0	134	4	$8.92	15%	20%	$0.01	2
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Strip Curtains for Walk-Ins	Strip Curtains for Walk-Ins	No Strip Curtains for Walk-In	Existing	0	178	4	$8.92	5%	20%	$0.00	5
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Strip Curtains for Walk-Ins	Strip Curtains for Walk-Ins	No Strip Curtains for Walk-In	Existing	0	268	4	$17.83	5%	20%	$0.01	7
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Strip Curtains for Walk-Ins	Strip Curtains for Walk-Ins	No Strip Curtains for Walk-In	Existing	0	268	4	$17.83	95%	20%	$0.01	52
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Strip Curtains for Walk-Ins	Strip Curtains for Walk-Ins	No Strip Curtains for Walk-In	Existing	0	268	4	$17.83	95%	20%	$0.01	19
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	582	19	$785.84	47%	95%	$0.14	1,822
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	582	19	$785.84	47%	95%	$0.14	591
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	1620	19	$2,186.69	47%	95%	$0.14	301
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	1620	19	$2,186.69	47%	95%	$0.14	98
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	860	19	$1,161.68	47%	95%	$0.14	735
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	860	19	$1,161.68	47%	95%	$0.14	238
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	886	19	$1,195.84	47%	95%	$0.14	344
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	886	19	$1,195.84	47%	95%	$0.14	112
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	784	19	$1,059.18	47%	95%	$0.14	5,393
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	784	19	$1,059.18	47%	95%	$0.14	1,750
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	607	19	$820.01	47%	95%	$0.14	3,190
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	607	19	$820.01	47%	95%	$0.14	1,035
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	177	19	$239.17	47%	95%	$0.14	352

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	177	19	$239.17	47%	95%	$0.14	114
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	2708	19	$3,655.87	47%	95%	$0.14	1,353
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	2708	19	$3,655.87	47%	95%	$0.14	439
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	2834	19	$3,826.70	47%	95%	$0.14	515
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	2834	19	$3,826.70	47%	95%	$0.14	167
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	Existing	0	3062	19	$4,134.21	47%	95%	$0.14	2,335
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Surface Parking Lighting	Surface Parking Lighting	Normal Lighting	New	0	3062	19	$4,134.21	47%	95%	$0.14	758
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	622	8	$261.70	10%	81%	$0.06	342
Electric	Energy Efficiency	Dry Goods Retail	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	622	8	$261.70	10%	81%	$0.06	114
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	2557	8	$1,075.23	10%	86%	$0.06	1,368
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	15	8	$6.25	10%	86%	$0.06	211
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	3579	8	$1,505.15	10%	86%	$0.06	509
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	901	8	$378.90	10%	86%	$0.06	157
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	1638	8	$688.85	10%	81%	$0.06	54
Electric	Energy Efficiency	Grocery	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	1638	8	$688.85	10%	81%	$0.06	18
Electric	Energy Efficiency	Grocery	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	10820	8	$4,550.34	10%	81%	$0.06	314
Electric	Energy Efficiency	Grocery	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	49	8	$20.70	10%	81%	$0.06	39
Electric	Energy Efficiency	Grocery	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	12034	8	$5,060.80	10%	81%	$0.06	95
Electric	Energy Efficiency	Grocery	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	1733	8	$728.94	10%	81%	$0.06	22
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	481	8	$202.15	10%	81%	$0.06	70
Electric	Energy Efficiency	Hospital	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	481	8	$202.15	10%	81%	$0.06	24
Electric	Energy Efficiency	Hospital	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	3410	8	$1,434.20	10%	100%	$0.06	581
Electric	Energy Efficiency	Hospital	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	3	8	$1.10	10%	100%	$0.06	12
Electric	Energy Efficiency	Hospital	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	3680	8	$1,547.47	10%	100%	$0.06	168
Electric	Energy Efficiency	Hospital	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	1382	8	$581.00	10%	100%	$0.06	91
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	563	8	$236.80	10%	81%	$0.06	38
Electric	Energy Efficiency	Hotel Motel	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	563	8	$236.80	10%	81%	$0.06	13
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	1277	8	$537.08	10%	100%	$0.06	96
Electric	Energy Efficiency	Hotel Motel	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	2	8	$0.65	10%	100%	$0.06	3

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	3583	8	$1,506.87	10%	100%	$0.06	70
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	4656	8	$1,957.94	10%	100%	$0.06	116
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	385	8	$162.07	10%	81%	$0.06	445
Electric	Energy Efficiency	Office	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	385	8	$162.07	10%	81%	$0.06	151
Electric	Energy Efficiency	Office	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	2960	8	$1,244.92	10%	88%	$0.06	3,510
Electric	Energy Efficiency	Office	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	4	8	$1.62	10%	88%	$0.06	123
Electric	Energy Efficiency	Office	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	2957	8	$1,243.45	10%	88%	$0.06	960
Electric	Energy Efficiency	Office	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	503	8	$211.33	10%	88%	$0.06	205
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	720	8	$302.60	10%	81%	$0.06	667
Electric	Energy Efficiency	Other Commercial	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	720	8	$302.60	10%	81%	$0.06	222
Electric	Energy Efficiency	Other Commercial	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	1285	8	$540.32	10%	100%	$0.06	1,346
Electric	Energy Efficiency	Other Commercial	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	15	8	$6.32	10%	100%	$0.06	416
Electric	Energy Efficiency	Other Commercial	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	1916	8	$805.96	10%	100%	$0.06	530
Electric	Energy Efficiency	Other Commercial	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	402	8	$168.90	10%	100%	$0.06	141
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	403	8	$169.35	10%	81%	$0.06	138
Electric	Energy Efficiency	Restaurant	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	403	8	$169.35	10%	81%	$0.06	46
Electric	Energy Efficiency	Restaurant	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	578	8	$243.22	10%	100%	$0.06	230
Electric	Energy Efficiency	Restaurant	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	1	8	$0.57	10%	100%	$0.06	14
Electric	Energy Efficiency	Restaurant	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	1044	8	$439.15	10%	100%	$0.06	111
Electric	Energy Efficiency	Restaurant	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	796	8	$334.75	10%	100%	$0.06	110
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	1982	8	$833.60	10%	81%	$0.06	174
Electric	Energy Efficiency	School	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	1982	8	$833.60	10%	81%	$0.06	58
Electric	Energy Efficiency	School	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	7902	8	$3,322.97	10%	95%	$0.06	750
Electric	Energy Efficiency	School	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	25	8	$10.53	10%	95%	$0.06	63
Electric	Energy Efficiency	School	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	7564	8	$3,180.83	10%	95%	$0.06	198
Electric	Energy Efficiency	School	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	418	8	$175.98	10%	95%	$0.06	18
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	2075	8	$872.55	10%	81%	$0.06	67
Electric	Energy Efficiency	University	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	2075	8	$872.55	10%	81%	$0.06	22
Electric	Energy Efficiency	University	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	6440	8	$2,708.20	10%	95%	$0.06	222

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	17	8	$7.34	10%	95%	$0.06	16
Electric	Energy Efficiency	University	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	8190	8	$3,444.28	10%	95%	$0.06	78
Electric	Energy Efficiency	University	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	2407	8	$1,012.25	10%	95%	$0.06	36
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	826	8	$347.30	10%	81%	$0.06	103
Electric	Energy Efficiency	Warehouse	Lighting Exterior	Retrofit	Time Clock	Time Clock	No Controls	New	0	826	8	$347.30	10%	81%	$0.06	35
Electric	Energy Efficiency	Warehouse	Lighting Interior Fluorescent	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	3294	8	$1,385.31	10%	100%	$0.06	523
Electric	Energy Efficiency	Warehouse	Lighting Interior HID	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	91	8	$38.43	10%	100%	$0.06	368
Electric	Energy Efficiency	Warehouse	Lighting Interior Other	Retrofit	Time Clock	Time Clock	No Controls	New	0	5604	8	$2,356.67	10%	100%	$0.06	224
Electric	Energy Efficiency	Warehouse	Lighting Interior Screw Base	Retrofit	Time Clock	Time Clock	No Controls	Existing	0	1619	8	$680.69	10%	100%	$0.06	85
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	83	9	$451.95	95%	95%	$0.89	159
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	37	9	$451.95	95%	95%	$2.00	46
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	78	9	$451.95	95%	95%	$0.95	154
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	78	9	$451.95	95%	95%	$0.95	44
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	244	9	$1,257.60	95%	95%	$0.85	13
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	112	9	$1,257.60	95%	95%	$1.85	4
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	228	9	$1,257.60	95%	95%	$0.90	13
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	234	9	$1,257.60	95%	95%	$0.88	4
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	600	9	$1,670.25	95%	90%	$0.45	209
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	275	9	$1,670.25	95%	90%	$1.00	61
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	563	9	$1,670.25	95%	90%	$0.48	202
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	571	9	$1,670.25	95%	90%	$0.47	59
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	762	9	$6,877.50	95%	85%	$1.49	92
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	353	9	$6,877.50	95%	85%	$3.23	27
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	715	9	$6,877.50	95%	85%	$1.59	89
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	736	9	$6,877.50	95%	85%	$1.54	27

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	182	9	$609.15	95%	85%	$0.54	831
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	84	9	$609.15	95%	85%	$1.19	244
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	171	9	$609.15	95%	85%	$0.58	802
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	176	9	$609.15	95%	85%	$0.56	238
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	114	9	$471.60	95%	95%	$0.67	326
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	52	9	$471.60	95%	95%	$1.49	95
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	107	9	$471.60	95%	95%	$0.72	314
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	109	9	$471.60	95%	95%	$0.71	92
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	774	9	$393.00	95%	75%	$0.07	416
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	351	9	$393.00	95%	75%	$0.17	120
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	726	9	$393.00	95%	75%	$0.08	402
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	730	9	$393.00	95%	75%	$0.08	117
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	2019	9	$2,102.55	95%	75%	$0.16	242
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	892	9	$2,102.55	95%	75%	$0.38	68
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	1894	9	$2,102.55	95%	75%	$0.17	234
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	1857	9	$2,102.55	95%	75%	$0.18	66
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	2114	9	$2,200.80	95%	75%	$0.16	92
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	934	9	$2,200.80	95%	75%	$0.38	26
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	1982	9	$2,200.80	95%	75%	$0.17	89
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	1944	9	$2,200.80	95%	75%	$0.18	25
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	302	9	$475.53	95%	95%	$0.25	170
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	138	9	$475.53	95%	95%	$0.56	49
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	0	283	9	$475.53	95%	95%	$0.26	164

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	0	287	9	$475.53	95%	95%	$0.26	48
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	VFD Rooftop Unit Supply Fan (Grocery Only)	VFD Rooftop Unit Supply Fan (Grocery Only)	Standard Supply Fan	Existing	0	5907	15	$3,675.00	90%	75%	$0.06	1,334
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	VFD Rooftop Unit Supply Fan (Grocery Only)	VFD Rooftop Unit Supply Fan (Grocery Only)	Standard Supply Fan	New	0	5907	15	$3,675.00	90%	75%	$0.06	480
Electric	Energy Efficiency	Dry Goods Retail	Vending Machines	Retrofit	Vending Miser	Passive Infrared Sensor on Vending Machine Monitoring Vacancy of Area And Cycles Cooling - Controls	No Vending Miser - No controls	Existing	0	80	10	$61.70	5%	25%	$0.11	5
Electric	Energy Efficiency	Grocery	Vending Machines	Retrofit	Vending Miser	Passive Infrared Sensor on Vending Machine Monitoring Vacancy of Area And Cycles Cooling - Controls	No Vending Miser - No controls	Existing	0	369	10	$426.10	75%	25%	$0.16	22
Electric	Energy Efficiency	Hospital	Vending Machines	Retrofit	Vending Miser	Passive Infrared Sensor on Vending Machine Monitoring Vacancy of Area And Cycles Cooling - Controls	No Vending Miser - No controls	Existing	0	85	10	$65.74	50%	25%	$0.11	15
Electric	Energy Efficiency	Hotel Motel	Vending Machines	Retrofit	Vending Miser	Passive Infrared Sensor on Vending Machine Monitoring Vacancy of Area And Cycles Cooling - Controls	No Vending Miser - No controls	Existing	0	141	10	$109.54	90%	25%	$0.11	21
Electric	Energy Efficiency	Office	Vending Machines	Retrofit	Vending Miser	Passive Infrared Sensor on Vending Machine Monitoring Vacancy of Area And Cycles Cooling - Controls	No Vending Miser - No controls	Existing	0	128	10	$99.62	10%	25%	$0.11	37
Electric	Energy Efficiency	Other Commercial	Vending Machines	Retrofit	Vending Miser	Passive Infrared Sensor on Vending Machine Monitoring Vacancy of Area And Cycles Cooling - Controls	No Vending Miser - No controls	Existing	0	85	10	$65.74	10%	25%	$0.11	19
Electric	Energy Efficiency	School	Vending Machines	Retrofit	Vending Miser	Passive Infrared Sensor on Vending Machine Monitoring Vacancy of Area And Cycles Cooling - Controls	No Vending Miser - No controls	Existing	0	383	10	$296.87	75%	25%	$0.11	60
Electric	Energy Efficiency	University	Vending Machines	Retrofit	Vending Miser	Passive Infrared Sensor on Vending Machine Monitoring Vacancy of Area And Cycles Cooling - Controls	No Vending Miser - No controls	Existing	0	401	10	$310.74	90%	25%	$0.11	28
Electric	Energy Efficiency	Warehouse	Vending Machines	Retrofit	Vending Miser	Passive Infrared Sensor on Vending Machine Monitoring Vacancy of Area And Cycles Cooling - Controls	No Vending Miser - No controls	Existing	0	158	10	$122.45	10%	25%	$0.11	5
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	Existing	0	995	10	$186.62	95%	85%	$0.01	338
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	New	0	995	10	$186.62	95%	85%	$0.01	110
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	Existing	0	529	10	$99.14	95%	85%	$0.01	826

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	New	0	529	10	$99.14	95%	85%	$0.01	268
Electric	Energy Efficiency	Hotel Motel	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	Existing	0	544	10	$102.06	95%	85%	$0.01	387
Electric	Energy Efficiency	Hotel Motel	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	New	0	544	10	$102.06	95%	85%	$0.01	125
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	Existing	0	373	10	$69.98	95%	85%	$0.01	3,584
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	New	0	373	10	$69.98	95%	85%	$0.01	1,163
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	Existing	0	109	10	$20.41	95%	85%	$0.01	395
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	New	0	109	10	$20.41	95%	85%	$0.01	128
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	Existing	0	1664	10	$312.01	95%	85%	$0.01	1,520
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	New	0	1664	10	$312.01	95%	85%	$0.01	493
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	Existing	0	1742	10	$326.59	95%	85%	$0.01	579
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Visi Cooler	High Efficiency Visi Cooler	Standard Visi Cooler	New	0	1742	10	$326.59	95%	85%	$0.01	188
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Walk-In Electronically Commutated Motor	ECM Evaporator Fans	Standard Efficiency Motor	Existing	0	3736	15	$482.82	95%	95%	$0.00	1,417
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Walk-In Electronically Commutated Motor	ECM Evaporator Fans	Standard Efficiency Motor	Existing	0	1245	15	$160.94	5%	95%	$0.00	114
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Walk-In Electronically Commutated Motor	ECM Evaporator Fans	Standard Efficiency Motor	Existing	0	1245	15	$160.94	3%	95%	$0.00	352
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Walk-In Electronically Commutated Motor	ECM Evaporator Fans	Standard Efficiency Motor	Existing	0	2491	15	$321.88	75%	95%	$0.00	7,973
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Walk-In Electronically Commutated Motor	ECM Evaporator Fans	Standard Efficiency Motor	Existing	0	2491	15	$321.88	10%	95%	$0.00	268
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Walk-In Electronically Commutated Motor	ECM Evaporator Fans	Standard Efficiency Motor	Existing	0	2491	15	$321.88	10%	95%	$0.00	97
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	0	1111	10	$29,120.00	3%	94%	$4.07	1
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	0	1042	10	$29,120.00	3%	94%	$4.34	1
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	0	73644	10	$29,120.00	3%	94%	$0.05	576
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	0	521	10	$107.09	3%	94%	$0.02	38
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	0	489	10	$107.09	3%	94%	$0.02	36
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	0	157	10	$107.09	3%	94%	$0.09	25

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	1902	10	$14,295.86	13%	66%	$1.17	280
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	1902	10	$14,295.86	13%	66%	$1.15	60
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	4820	10	$28,252.75	13%	66%	$0.91	54
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	4820	10	$28,252.75	13%	66%	$0.90	12
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	2818	10	$19,562.66	24%	66%	$1.07	230
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	2818	10	$19,562.66	24%	66%	$1.06	30
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Window Film	Window Film	No Film	Existing	0	2836	10	$19,562.66	24%	66%	$1.07	83
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	2567	10	$41,462.99	24%	66%	$2.51	32
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	2567	10	$41,462.99	24%	66%	$2.50	56
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Window Film	Window Film	No Film	Existing	0	2567	10	$41,462.99	24%	66%	$2.51	42
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	2077	10	$22,354.90	24%	66%	$1.67	1,037
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	2077	10	$22,354.90	24%	66%	$1.66	788
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Window Film	Window Film	No Film	Existing	0	2904	10	$22,354.90	24%	66%	$1.19	652
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	1941	10	$7,632.74	13%	66%	$0.61	295
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	1941	10	$7,632.74	13%	66%	$0.59	91
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Window Film	Window Film	No Film	Existing	0	1913	10	$7,632.74	13%	66%	$0.62	59
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	1263	10	$6,341.28	19%	66%	$0.78	187
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	1263	10	$6,341.28	19%	66%	$0.77	47
Electric	Energy Efficiency	School	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	1595	10	$62,623.85	24%	66%	$6.12	34
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	1595	10	$62,623.85	24%	66%	$6.09	37
Electric	Energy Efficiency	School	Cooling Chillers	Retrofit	Window Film	Window Film	No Film	Existing	0	1740	10	$62,623.85	24%	66%	$5.61	36
Electric	Energy Efficiency	University	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	1670	10	$65,550.20	24%	66%	$6.12	3
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	1670	10	$65,550.20	24%	66%	$6.09	1
Electric	Energy Efficiency	University	Cooling Chillers	Retrofit	Window Film	Window Film	No Film	Existing	0	1821	10	$65,550.20	24%	66%	$5.61	2
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Window Film	Window Film	No Film	Existing	0	1000	10	$18,932.44	6%	66%	$2.95	7
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Window Film	Window Film	No Film	Existing	0	1000	10	$18,932.44	6%	66%	$2.92	2
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Window Film	Window Film	No Film	Existing	0	988	10	$18,932.44	6%	66%	$2.98	2
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2738	45	$1,860.34	15%	80%	$0.06	961
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1354	45	$1,860.34	80%	80%	$0.13	863

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2472	45	$1,860.34	15%	80%	$0.06	165
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1220	45	$1,860.34	80%	80%	$0.13	145
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	6937	45	$3,676.56	15%	85%	$0.05	166
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	5818	45	$3,676.56	80%	85%	$0.06	296
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	3170	45	$3,676.56	15%	85%	$0.10	16
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	5243	45	$3,676.56	80%	85%	$0.05	54
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	4056	45	$2,545.71	15%	60%	$0.05	237
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1058	45	$2,545.71	80%	60%	$0.23	142
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2855	45	$2,545.71	15%	60%	$0.07	24
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	324	45	$2,545.71	80%	60%	$0.76	4
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	4081	45	$2,545.71	15%	60%	$0.05	109
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	901	45	$2,545.71	80%	60%	$0.27	45
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	3694	45	$5,395.62	15%	50%	$0.14	29
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1173	45	$5,395.62	80%	50%	$0.45	19
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2003	45	$5,395.62	15%	50%	$0.25	23
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	148	45	$5,395.62	80%	50%	$3.61	3
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	3695	45	$5,395.62	15%	50%	$0.14	38
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	999	45	$5,395.62	80%	50%	$0.53	21
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2990	45	$2,909.06	15%	95%	$0.09	1,842
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1064	45	$2,909.06	80%	95%	$0.27	1,448
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2196	45	$2,909.06	15%	95%	$0.11	1,098
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	712	45	$2,909.06	80%	95%	$0.38	603
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	4179	45	$2,909.06	15%	95%	$0.06	1,292
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1303	45	$2,909.06	80%	95%	$0.21	824
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2793	45	$993.25	15%	70%	$0.03	876
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1243	45	$993.25	80%	70%	$0.07	709
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2177	45	$993.25	15%	70%	$0.03	201
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	921	45	$993.25	80%	70%	$0.09	149
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2754	45	$993.25	15%	70%	$0.03	156

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1059	45	$993.25	80%	70%	$0.09	110
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	1818	45	$825.19	15%	80%	$0.04	439
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	680	45	$825.19	80%	80%	$0.11	300
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	1688	45	$825.19	15%	80%	$0.04	101
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	531	45	$825.19	80%	80%	$0.14	55
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	1364	45	$8,149.30	15%	60%	$0.56	19
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	586	45	$8,149.30	80%	60%	$1.35	16
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	1428	45	$8,530.11	15%	60%	$0.56	0
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	614	45	$8,530.11	80%	60%	$1.35	0
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	1440	45	$2,463.70	15%	98%	$0.16	43
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1741	45	$2,463.70	80%	98%	$0.13	98
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	157	45	$2,463.70	15%	98%	$1.53	0
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	983	45	$2,463.70	80%	98%	$0.21	20
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	1421	45	$2,463.70	15%	98%	$0.17	10
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	1483	45	$2,463.70	80%	98%	$0.16	20
Electric	Energy Efficiency	Dry Goods Retail	Cooling DX	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	2328	45	$16,787.65	15%	80%	$0.70	648
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	2628	45	$16,787.65	15%	80%	$0.62	131
Electric	Energy Efficiency	Grocery	Cooling DX	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	6072	45	$33,177.25	15%	85%	$0.52	125
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	6744	45	$33,177.25	15%	85%	$0.47	27
Electric	Energy Efficiency	Hospital	Cooling DX	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	3475	45	$22,972.46	15%	60%	$0.60	191
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	3864	45	$22,972.46	15%	60%	$0.57	25
Electric	Energy Efficiency	Hospital	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	3496	45	$22,972.46	15%	60%	$0.64	77
Electric	Energy Efficiency	Hotel Motel	Cooling DX	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	3233	45	$48,690.05	15%	50%	$1.48	19
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	3413	45	$48,690.05	15%	50%	$1.40	36
Electric	Energy Efficiency	Hotel Motel	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	3234	45	$48,690.05	15%	50%	$1.47	28
Electric	Energy Efficiency	Office	Cooling DX	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	2727	45	$26,251.39	15%	95%	$0.95	1,464
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	2669	45	$26,251.39	15%	95%	$0.96	935
Electric	Energy Efficiency	Office	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	3812	45	$26,251.39	15%	95%	$0.68	931
Electric	Energy Efficiency	Other Commercial	Cooling DX	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	2445	45	$8,963.15	15%	70%	$0.35	601

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	2524	45	$8,963.15	15%	70%	$0.33	171
Electric	Energy Efficiency	Other Commercial	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	2410	45	$8,963.15	15%	70%	$0.36	110
Electric	Energy Efficiency	Restaurant	Cooling DX	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	1591	45	$7,446.57	15%	80%	$0.46	234
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	1598	45	$7,446.57	15%	80%	$0.45	59
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	18507	45	$73,539.29	15%	60%	$0.37	286
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	19371	45	$76,975.70	15%	60%	$0.37	6
Electric	Energy Efficiency	Warehouse	Cooling DX	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	1260	45	$22,232.39	15%	98%	$1.72	39
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	1544	45	$22,232.39	15%	98%	$1.40	14
Electric	Energy Efficiency	Warehouse	Cooling Chillers	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	1244	45	$22,232.39	15%	98%	$1.75	9
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	128	9	$4.58	95%	75%	-$0.01	119
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	58	9	$4.58	95%	75%	$0.00	56
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	120	9	$4.58	95%	75%	-$0.01	115
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	120	9	$4.58	95%	75%	-$0.01	54
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	174	9	$12.74	95%	75%	$0.00	5
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	362	9	$12.74	95%	75%	-$0.01	5
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	927	9	$16.92	95%	75%	-$0.01	233
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	424	9	$16.92	95%	75%	-$0.01	78
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	870	9	$16.92	95%	75%	-$0.01	225
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	883	9	$16.92	95%	75%	-$0.01	76
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	1178	9	$69.65	95%	75%	-$0.01	108
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	546	9	$69.65	95%	75%	$0.01	37
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	1105	9	$69.65	95%	75%	$0.00	105
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	1137	9	$69.65	95%	75%	$0.00	36
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	282	9	$6.17	95%	75%	-$0.01	904
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	130	9	$6.17	95%	75%	-$0.01	333
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	264	9	$6.17	95%	75%	-$0.01	872
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	271	9	$6.17	95%	75%	-$0.01	324
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	177	9	$4.78	95%	75%	-$0.01	290
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	81	9	$4.78	95%	75%	-$0.01	115

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	166	9	$4.78	95%	75%	-$0.01	280
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	168	9	$4.78	95%	75%	-$0.01	112
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	1197	9	$3.98	95%	75%	-$0.01	606
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	542	9	$3.98	95%	75%	-$0.01	185
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	1122	9	$3.98	95%	75%	-$0.01	585
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	1129	9	$3.98	95%	75%	-$0.01	181
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	3121	9	$21.29	95%	75%	-$0.01	334
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	1379	9	$21.29	95%	75%	-$0.01	105
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	2927	9	$21.29	95%	75%	-$0.01	322
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	2870	9	$21.29	95%	75%	-$0.01	102
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	3267	9	$22.29	95%	75%	-$0.01	129
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	1444	9	$22.29	95%	75%	-$0.01	40
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	3064	9	$22.29	95%	75%	-$0.01	124
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	3004	9	$22.29	95%	75%	-$0.01	39
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	466	9	$4.82	95%	75%	-$0.02	173
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	213	9	$4.82	95%	75%	-$0.01	60
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	0	438	9	$4.82	95%	75%	-$0.02	167
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	0	444	9	$4.82	95%	75%	-$0.02	59
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	88	10	$61.89	95%	73%	$0.09	25
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	88	10	$61.89	95%	73%	$0.09	16
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	183	10	$61.89	95%	73%	$0.04	53
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	183	10	$61.89	95%	73%	$0.04	15
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	2511	10	$1,274.18	95%	73%	$0.06	262
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	2511	10	$1,274.18	95%	73%	$0.06	166
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	5226	10	$1,274.18	95%	73%	$0.02	560
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	5226	10	$1,274.18	95%	73%	$0.02	162
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	15	10	$14.11	95%	73%	$0.13	59
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	15	10	$14.11	95%	73%	$0.13	37
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	31	10	$14.11	95%	73%	$0.05	126

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	31	10	$14.11	95%	73%	$0.05	36
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	12	10	$10.92	95%	73%	$0.13	25
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	12	10	$10.92	95%	73%	$0.13	16
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	24	10	$10.92	95%	73%	$0.05	55
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	24	10	$10.92	95%	73%	$0.05	16
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	402	10	$347.80	95%	73%	$0.12	47
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	402	10	$347.80	95%	73%	$0.12	30
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	836	10	$347.80	95%	73%	$0.05	100
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	836	10	$347.80	95%	73%	$0.05	29
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	421	10	$364.05	95%	73%	$0.12	18
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	421	10	$364.05	95%	73%	$0.12	11
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	0	875	10	$364.05	95%	73%	$0.05	38
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	0	875	10	$364.05	95%	73%	$0.05	11
Electric	Energy Efficiency	Dry Goods Retail	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	303	16	$138.17	95%	50%	$0.04	1,018
Electric	Energy Efficiency	Grocery	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	387	16	$176.58	95%	50%	$0.04	77
Electric	Energy Efficiency	Hospital	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	345	16	$157.71	95%	50%	$0.04	317
Electric	Energy Efficiency	Hotel Motel	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	70	16	$32.00	95%	50%	$0.04	29
Electric	Energy Efficiency	Office	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	70	16	$32.00	95%	50%	$0.04	518
Electric	Energy Efficiency	Other Commercial	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	123	16	$56.11	95%	50%	$0.04	694
Electric	Energy Efficiency	Restaurant	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	123	16	$56.00	95%	50%	$0.04	262
Electric	Energy Efficiency	School	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	79	16	$36.15	95%	50%	$0.04	43
Electric	Energy Efficiency	University	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	302	16	$137.86	95%	50%	$0.04	59
Electric	Energy Efficiency	Warehouse	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	70	16	$32.00	95%	50%	$0.04	57
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	3092	15	$8,386.38	5%	95%	$0.32	66
Electric	Energy Efficiency	Dry Goods Retail	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	1525	15	$6,709.10	5%	95%	$0.54	12
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	7208	15	$15,557.34	5%	95%	$0.26	11
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	5997	15	$12,445.88	5%	95%	$0.25	3
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	4297	15	$8,264.84	5%	95%	$0.23	16

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	1090	15	$6,611.87	5%	95%	$0.75	1
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	3743	15	$8,507.92	5%	95%	$0.27	28
Electric	Energy Efficiency	Hotel Motel	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	1186	15	$6,806.34	5%	95%	$0.71	3
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	3276	15	$7,535.59	5%	95%	$0.27	422
Electric	Energy Efficiency	Office	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	1221	15	$6,028.47	5%	95%	$0.61	62
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	2935	15	$6,563.25	5%	95%	$0.26	89
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	1280	15	$5,250.61	5%	95%	$0.50	13
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	1933	15	$3,403.17	5%	95%	$0.21	31
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	652	15	$2,722.53	5%	95%	$0.52	3
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	2391	15	$34,679.91	5%	95%	$1.81	17
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	1157	15	$27,743.93	5%	95%	$3.02	3
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	2502	15	$36,300.48	5%	95%	$1.81	0
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	1211	15	$29,040.38	5%	95%	$3.02	0
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	Existing	0	1514	15	$22,059.83	5%	95%	$1.82	4
Electric	Energy Efficiency	Warehouse	Heat Pump	Retrofit	Water Source Heat Pump > 135 kBTU/hr	High Efficiency Water Source Heat Pump > 135 kBTU/hr	Standard Water Source Heat Pump > 135 kBTU/hr	New	0	1824	15	$17,647.86	5%	95%	$1.19	2
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	Existing	0	22142	12	$34,329.62	15%	95%	$0.21	1,326
Electric	Energy Efficiency	Grocery	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	New	0	21100	12	$32,713.35	15%	95%	$0.21	410
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	Existing	0	288	12	$447.14	15%	95%	$0.21	79
Electric	Energy Efficiency	Hospital	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	New	0	352	12	$546.50	15%	95%	$0.21	32
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	Existing	0	81	12	$126.25	15%	95%	$0.21	138
Electric	Energy Efficiency	Other Commercial	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	New	0	100	12	$154.31	15%	95%	$0.21	55
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	Existing	0	653	12	$1,012.63	15%	95%	$0.21	418
Electric	Energy Efficiency	Restaurant	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	New	0	798	12	$1,237.66	15%	95%	$0.21	166

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	Existing	0	908	12	$1,407.16	15%	95%	$0.21	146
Electric	Energy Efficiency	School	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	New	0	908	12	$1,407.16	15%	95%	$0.21	47
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	Existing	0	950	12	$1,472.92	15%	95%	$0.21	56
Electric	Energy Efficiency	University	Refrigeration	Retrofit	Add Doors to Refrigerated Open Display Cases	Add Doors to Refrigerated Open Display Cases	Standard Refrigerated Open Display Cases	New	0	950	12	$1,472.92	15%	95%	$0.21	18
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	Existing	0	39480	15	$6,907.43	25%	95%	$0.01	437
Electric	Energy Efficiency	Grocery	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	New	0	14269	15	$6,907.43	75%	95%	$0.05	155
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	Existing	0	16651	15	$3,669.58	25%	95%	$0.01	421
Electric	Energy Efficiency	Hospital	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	New	0	7075	15	$3,669.58	75%	95%	$0.05	178
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	Existing	0	9750	15	$2,914.06	25%	95%	$0.02	2,072
Electric	Energy Efficiency	Other Commercial	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	New	0	4452	15	$2,914.06	75%	95%	$0.06	940
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	Existing	0	4608	15	$1,511.01	25%	95%	$0.03	555
Electric	Energy Efficiency	Restaurant	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	New	0	1827	15	$1,511.01	75%	95%	$0.09	220
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	Existing	0	38932	15	$15,397.83	25%	95%	$0.02	2,192
Electric	Energy Efficiency	School	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	New	0	16733	15	$15,397.83	75%	95%	$0.09	926
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	Existing	0	40752	15	$16,117.35	25%	95%	$0.02	46
Electric	Energy Efficiency	University	Heat Pump	Retrofit	Variable Refrigerant Flow Cooling System	Variable Refrigerant Flow Cooling System	Standard Refrigeration System	New	0	17515	15	$16,117.35	75%	95%	$0.09	20
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	15	12	$44.74	24%	25%	$0.42	2
Electric	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	15	12	$44.74	24%	55%	$0.42	3
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	15	12	$44.74	24%	25%	$0.42	2
Electric	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	15	12	$44.74	24%	55%	$0.42	1
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	14	12	$43.22	24%	25%	$0.42	0
Electric	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	14	12	$43.22	24%	55%	$0.42	0
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	14	12	$43.22	24%	25%	$0.42	0
Electric	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277	RTF Market Standard 2014 Dishwasher -	New	0	14	12	$43.22	24%	55%	$0.42	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						kWh/yr and 4.25 gal/cycle	289 kWh/yr and 5.0 gal/cycle									
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	20	12	$60.60	11%	25%	$0.42	0
Electric	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	20	12	$60.60	11%	55%	$0.42	0
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	20	12	$60.60	11%	25%	$0.42	0
Electric	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	20	12	$60.60	11%	55%	$0.42	0
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	33	12	$100.47	24%	25%	$0.42	0
Electric	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	33	12	$100.47	24%	55%	$0.42	0
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	33	12	$100.47	24%	25%	$0.42	0
Electric	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	33	12	$100.47	24%	55%	$0.42	0
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	22	12	$66.59	8%	25%	$0.42	2
Electric	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	22	12	$66.59	8%	55%	$0.42	3
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	22	12	$66.59	8%	25%	$0.42	3
Electric	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	22	12	$66.59	8%	55%	$0.42	2
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	15	12	$44.71	5%	25%	$0.42	1
Electric	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	15	12	$44.71	5%	55%	$0.42	1
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	15	12	$44.71	5%	25%	$0.42	1
Electric	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	15	12	$44.71	5%	55%	$0.42	0
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	15	12	$46.35	46%	25%	$0.42	1

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	15	12	$46.35	46%	55%	$0.42	2
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	15	12	$46.35	46%	25%	$0.42	1
Electric	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	15	12	$46.35	46%	55%	$0.42	1
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	14	12	$42.00	35%	25%	$0.42	0
Electric	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	14	12	$42.00	35%	55%	$0.42	0
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	14	12	$42.00	35%	25%	$0.42	0
Electric	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	14	12	$42.00	35%	55%	$0.42	0
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	31	12	$94.22	35%	25%	$0.42	0
Electric	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	31	12	$94.22	35%	55%	$0.42	0
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	31	12	$94.22	35%	25%	$0.42	0
Electric	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	31	12	$94.22	35%	55%	$0.42	0
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	14	12	$41.61	3%	25%	$0.42	0
Electric	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	14	12	$41.61	3%	55%	$0.42	0
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	0	14	12	$41.61	3%	25%	$0.42	0
Electric	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	0	14	12	$41.61	3%	55%	$0.42	0
Electric	Energy Efficiency	Grocery	Lighting Interior Fluorescent	Retrofit	LED Refrigeration Case Lights	LED Refrigeration Case Lights	Fluorescent Refrigeration Case	Existing	0	40036	6	$11,213.18	95%	80%	$0.05	11,185
Electric	Energy Efficiency	Grocery	Lighting Interior Other	Retrofit	LED Refrigeration Case Lights	LED Refrigeration Case Lights	Fluorescent Refrigeration Case	New	0	30981	6	$11,213.18	95%	80%	$0.06	2,407
Electric	Energy Efficiency	Hospital	Lighting Interior Other	Retrofit	LED Refrigeration Case Lights	LED Refrigeration Case Lights	Fluorescent Refrigeration Case	New	0	404	6	$146.05	15%	80%	$0.06	23
Electric	Energy Efficiency	Other Commercial	Lighting Interior Other	Retrofit	LED Refrigeration Case Lights	LED Refrigeration Case Lights	Fluorescent Refrigeration Case	New	0	114	6	$41.24	10%	80%	$0.04	26

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Lighting Interior Fluorescent	Retrofit	LED Refrigeration Case Lights	LED Refrigeration Case Lights	Fluorescent Refrigeration Case	Existing	0	1181	6	$330.76	25%	80%	$0.04	712
Electric	Energy Efficiency	Restaurant	Lighting Interior Other	Retrofit	LED Refrigeration Case Lights	LED Refrigeration Case Lights	Fluorescent Refrigeration Case	New	0	914	6	$330.76	25%	80%	$0.06	200
Electric	Energy Efficiency	School	Lighting Interior Other	Retrofit	LED Refrigeration Case Lights	LED Refrigeration Case Lights	Fluorescent Refrigeration Case	New	0	1270	6	$459.63	10%	80%	$0.06	28
Electric	Energy Efficiency	University	Lighting Interior Other	Retrofit	LED Refrigeration Case Lights	LED Refrigeration Case Lights	Fluorescent Refrigeration Case	New	0	1329	6	$481.10	10%	80%	$0.06	11
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	2044	15	$2,875.00	25%	94%	$0.11	527
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	1888	15	$4,250.00	5%	94%	$0.17	68
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	1236	15	$4,375.00	50%	94%	$0.40	106
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	4381	15	$3,875.00	75%	94%	$0.03	15,915
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	2762	15	$3,000.00	50%	94%	$0.08	4,366
Electric	Energy Efficiency	School	Space Heat	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	26704	15	$13,375.00	25%	94%	$0.03	451
Electric	Energy Efficiency	University	Space Heat	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	0	27952	15	$14,000.00	25%	94%	$0.03	222
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	5555	15	$34,943.57	15%	67%	$0.73	460
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	5130	15	$51,655.72	15%	67%	$1.18	293
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	16802	15	$53,175.00	15%	67%	$0.36	317
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	11906	15	$47,097.85	15%	67%	$0.43	4,491
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	7507	15	$36,462.85	15%	67%	$0.56	1,924
Electric	Energy Efficiency	School	Space Heat	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	72574	15	$162,563.57	15%	67%	$0.25	399
Electric	Energy Efficiency	University	Space Heat	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	0	75965	15	$170,160.00	15%	67%	$0.25	198
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	0	3974	8	$11,216.93	75%	59%	$0.44	496
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	0	11736	8	$31,212.31	75%	61%	$0.42	44
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	3974	8	$8,510.00	50%	80%	$0.32	1,244

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	11736	8	$23,680.00	50%	80%	$0.31	7
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	3671	8	$12,580.00	75%	80%	$0.52	1,298
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	12022	8	$12,950.00	50%	80%	$0.15	921
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	8519	8	$11,470.00	50%	80%	$0.17	13,090
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	5371	8	$8,880.00	50%	80%	$0.24	5,585
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	811	8	$2,590.00	50%	100%	$0.51	21
Electric	Energy Efficiency	School	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	51927	8	$39,590.00	50%	80%	$0.11	1,110
Electric	Energy Efficiency	University	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	54354	8	$41,440.00	50%	80%	$0.11	567
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	0	11712	8	$44,770.00	50%	98%	$0.64	870
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	2020	18	$8,625.00	45%	65%	$0.43	549
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	5964	18	$16,000.00	45%	65%	$0.26	47
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	1865	18	$8,500.00	45%	65%	$0.48	354
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	6109	18	$8,750.00	45%	65%	$0.13	369
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	4329	18	$7,750.00	45%	65%	$0.14	5,217
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	2730	18	$6,750.00	45%	65%	$0.23	2,235
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	412	18	$3,500.00	45%	65%	$0.92	36
Electric	Energy Efficiency	School	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	26388	18	$35,666.67	45%	65%	$0.13	464
Electric	Energy Efficiency	University	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	27621	18	$37,333.33	45%	65%	$0.13	230
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	0	5952	18	$22,687.50	45%	65%	$0.40	343
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	3484	14	$28,078.84	5%	94%	$1.01	131
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	773	14	$28,078.84	5%	94%	$4.73	14
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	10287	14	$78,132.42	5%	94%	$0.95	12
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	892	14	$78,132.42	5%	94%	$11.47	0
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	3218	14	$41,507.85	5%	94%	$1.67	84
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	1765	14	$41,507.85	5%	94%	$3.06	21

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	10538	14	$42,728.68	5%	94%	$0.50	90
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	6705	14	$42,728.68	5%	94%	$0.81	26
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	7467	14	$37,845.39	5%	94%	$0.63	1,281
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	1539	14	$37,845.39	5%	94%	$3.20	115
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	4708	14	$29,299.66	5%	94%	$0.77	549
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	999	14	$29,299.66	5%	94%	$3.81	55
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	711	14	$8,545.73	5%	94%	$1.54	9
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	163	14	$8,545.73	5%	94%	$6.85	1
Electric	Energy Efficiency	School	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	45519	14	$130,627.65	5%	94%	$0.35	114
Electric	Energy Efficiency	School	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	14753	14	$130,627.65	5%	94%	$1.13	17
Electric	Energy Efficiency	University	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	47646	14	$136,731.75	5%	94%	$0.35	56
Electric	Energy Efficiency	University	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	15443	14	$136,731.75	5%	94%	$1.13	8
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	0	10267	14	$147,719.12	5%	94%	$1.85	74
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	0	3388	14	$147,719.12	5%	94%	$5.69	11
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	47	10	$439.33	64%	85%	$1.31	1
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	47	10	$439.33	64%	85%	$1.31	0
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	9	10	$88.86	62%	85%	$1.09	3
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	9	10	$88.86	62%	85%	$1.09	1
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	11	10	$106.96	58%	85%	$1.20	1
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned	Hood Pulls Conditioned Air (No Make-up Air)	New	0	11	10	$106.96	58%	85%	$1.20	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
						Air										
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	7	10	$64.17	100%	85%	$1.32	14
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	7	10	$64.17	100%	85%	$1.32	7
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	165	10	$1,550.00	100%	85%	$1.36	37
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	165	10	$1,550.00	100%	85%	$1.36	16
Electric	Energy Efficiency	School	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	4	10	$36.20	73%	85%	$1.38	0
Electric	Energy Efficiency	School	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	4	10	$36.20	73%	85%	$1.38	0
Electric	Energy Efficiency	University	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	0	7	10	$69.11	73%	85%	$1.40	0
Electric	Energy Efficiency	University	Space Heat	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	0	7	10	$69.11	73%	85%	$1.40	0
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	2323	13	$782.39	10%	39%	-$0.01	118
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	6858	13	$1,546.21	10%	39%	-$0.02	9
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	2145	13	$1,070.63	10%	39%	$0.00	66
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	7025	13	$2,269.19	10%	39%	$0.01	66
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	4978	13	$1,223.44	10%	39%	-$0.02	1,019
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	3139	13	$417.73	10%	39%	-$0.04	462
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	474	13	$347.05	10%	39%	$0.04	7
Electric	Energy Efficiency	School	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	30346	13	$3,427.28	10%	39%	-$0.02	90
Electric	Energy Efficiency	University	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	31764	13	$3,587.43	10%	39%	-$0.02	43

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	0	6844	13	$1,036.14	10%	39%	-$0.03	58
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	493	45	$1,121.61	25%	83%	$0.18	108
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	109	45	$1,121.61	75%	83%	$0.97	27
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1477	45	$3,231.34	25%	70%	$0.17	5
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	128	45	$3,231.34	75%	70%	$2.46	1
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	398	45	$1,224.18	25%	70%	$0.28	50
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	218	45	$1,224.18	75%	70%	$0.53	29
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	987	45	$760.06	25%	70%	$0.05	40
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	628	45	$760.06	75%	70%	$0.09	27
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	881	45	$1,015.76	25%	50%	$0.08	509
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	181	45	$1,015.76	75%	50%	$0.52	110
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	666	45	$1,171.20	25%	70%	$0.12	388
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	141	45	$1,171.20	75%	70%	$0.77	89
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	99	45	$329.50	25%	83%	$0.28	5
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	23	45	$329.50	75%	83%	$1.40	2
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	3897	45	$5,559.24	25%	70%	$0.11	44
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	1263	45	$5,559.24	75%	70%	$0.41	16
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	4079	45	$2,593.70	25%	70%	$0.03	23
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	1322	45	$2,593.70	75%	70%	$0.16	8
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	0	1497	45	$6,345.83	25%	70%	$0.38	50
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	0	494	45	$6,345.83	75%	70%	$1.23	18
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	476	45	$1,121.61	25%	98%	$0.18	125
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	106	45	$1,121.61	75%	98%	$1.00	30
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1427	45	$3,231.36	25%	85%	$0.18	10
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	124	45	$3,231.36	75%	85%	$2.55	1
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	384	45	$1,224.19	25%	85%	$0.29	62
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	211	45	$1,224.19	75%	85%	$0.55	34
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	954	45	$760.04	25%	85%	$0.05	48
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	607	45	$760.04	75%	85%	$0.10	32

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	852	45	$1,015.74	25%	65%	$0.08	658
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	175	45	$1,015.74	75%	65%	$0.54	138
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	644	45	$1,171.20	25%	85%	$0.13	462
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	137	45	$1,171.20	75%	85%	$0.80	104
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	96	45	$329.48	25%	98%	$0.30	8
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	22	45	$329.48	75%	98%	$1.45	2
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	5413	45	$5,559.24	25%	85%	$0.07	81
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	1754	45	$5,559.24	75%	85%	$0.28	28
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	5666	45	$2,593.70	25%	85%	$0.01	42
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	1836	45	$2,593.70	75%	85%	$0.11	14
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	0	1447	45	$6,345.83	25%	85%	$0.39	61
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	0	477	45	$6,345.83	75%	85%	$1.27	21
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	5341	45	$8,202.62	25%	85%	$0.10	1,436
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	16001	45	$23,631.63	25%	10%	$0.10	13
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	3158	45	$8,952.76	25%	13%	$0.25	78
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	7837	45	$5,558.44	25%	25%	$0.04	118
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	6997	45	$7,428.40	25%	4%	$0.07	334
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	5293	45	$8,565.26	25%	30%	$0.11	1,363
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	787	45	$2,409.66	25%	85%	$0.26	61
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	186678	45	$40,656.02	25%	15%	-$0.01	533
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	195401	45	$18,968.30	25%	13%	-$0.02	232
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	0	16218	45	$46,408.56	25%	10%	$0.24	82
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	976	20	$2,834.63	75%	59%	$0.26	460
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	2880	20	$7,887.68	75%	60%	$0.25	40
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	901	20	$4,190.34	75%	60%	$0.47	271
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	2951	20	$4,313.57	75%	60%	$0.12	315
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	2091	20	$3,820.59	75%	59%	$0.13	3,867
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	1318	20	$2,957.88	75%	59%	$0.19	1,876
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	199	20	$862.71	75%	56%	$0.42	28

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	12745	20	$13,187.21	75%	55%	$0.08	371
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	13341	20	$13,803.44	75%	55%	$0.08	183
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	0	2875	20	$14,912.65	75%	58%	$0.53	241
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	5287	45	$10,918.19	35%	90%	$0.15	1,978
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	15803	45	$31,455.14	35%	45%	$0.15	81
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	1945	45	$11,916.68	35%	35%	$0.58	156
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	16627	45	$7,398.62	35%	45%	$0.02	660
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	9748	45	$9,887.66	35%	15%	$0.06	2,473
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	10386	45	$11,400.89	35%	50%	$0.06	6,674
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	1065	45	$3,207.40	35%	90%	$0.25	131
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	70620	45	$54,115.67	35%	35%	$0.04	643
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	53368	45	$25,247.98	35%	35%	$0.02	227
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	0	23221	45	$61,772.64	35%	45%	$0.22	778
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	984	45	$1,788.32	35%	90%	$0.13	373
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	218	45	$1,788.32	35%	90%	$0.76	28
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	2942	45	$5,152.14	35%	45%	$0.13	15
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	255	45	$5,152.14	35%	45%	$1.96	0
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	812	45	$1,951.87	35%	35%	$0.21	77
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	445	45	$1,951.87	35%	35%	$0.41	14
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	2130	45	$1,211.85	35%	45%	$0.03	81
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	1355	45	$1,211.85	35%	45%	$0.06	18
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	1814	45	$1,619.53	35%	15%	$0.05	456
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	374	45	$1,619.53	35%	15%	$0.39	32
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	1330	45	$1,867.38	35%	50%	$0.09	805
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	282	45	$1,867.38	35%	50%	$0.61	60
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	198	45	$525.35	35%	90%	$0.22	25
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	45	45	$525.35	35%	90%	$1.10	2
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	13145	45	$8,863.77	35%	35%	$0.04	116
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	4261	45	$8,863.77	35%	35%	$0.18	13

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	9934	45	$4,135.45	35%	35%	$0.01	41
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	3220	45	$4,135.45	35%	35%	$0.10	5
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	0	2974	45	$10,117.93	35%	45%	$0.29	94
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	0	981	45	$10,117.93	35%	45%	$0.98	11
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	10660	45	$8,787.76	10%	35%	$0.03	480
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	30749	45	$22,153.46	10%	35%	$0.03	36
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	11830	45	$9,105.59	10%	35%	$0.05	326
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	49572	45	$14,308.63	10%	35%	$0.00	455
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	28883	45	$13,364.83	10%	35%	$0.01	5,317
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	14399	45	$6,977.60	10%	35%	$0.00	1,906
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	2225	45	$3,663.90	10%	35%	$0.12	31
Electric	Energy Efficiency	School	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	114957	45	$16,486.32	10%	35%	-$0.02	312
Electric	Energy Efficiency	University	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	120329	45	$17,256.71	10%	35%	-$0.02	151
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	0	29894	45	$36,252.27	10%	35%	$0.07	226
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	515	30	$1,725.00	10%	95%	$0.27	20
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	595	30	$4,800.00	10%	95%	$0.69	1
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	1177	30	$2,550.00	10%	95%	$0.19	29
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	4470	30	$2,625.00	10%	95%	$0.03	36
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	1026	30	$2,325.00	10%	95%	$0.14	160
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	666	30	$1,800.00	10%	95%	$0.22	77
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	109	30	$525.00	10%	95%	$0.43	1
Electric	Energy Efficiency	School	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	9835	30	$8,025.00	10%	95%	$0.05	24
Electric	Energy Efficiency	University	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	10295	30	$8,400.00	10%	95%	$0.05	12
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	0	2258	30	$9,075.00	10%	95%	$0.37	15
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1161	10	$351.92	95%	26%	-$0.02	369
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	258	10	$351.92	95%	13%	$0.13	13

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	3429	10	$339.91	95%	31%	-$0.04	33
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	297	10	$339.91	95%	15%	$0.02	0
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1073	10	$476.65	95%	24%	-$0.03	192
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	588	10	$476.65	95%	12%	$0.07	17
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	3513	10	$790.29	95%	31%	-$0.01	264
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	2235	10	$790.29	95%	15%	$0.02	28
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	2489	10	$523.76	95%	26%	-$0.04	3,253
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	513	10	$523.76	95%	13%	$0.06	103
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	1569	10	$351.68	95%	28%	-$0.02	1,576
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	333	10	$351.68	95%	14%	$0.10	55
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	237	10	$364.60	95%	25%	$0.17	19
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	54	10	$364.60	95%	13%	$0.96	1
Electric	Energy Efficiency	School	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	15173	10	$330.32	95%	21%	-$0.03	232
Electric	Energy Efficiency	School	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	4918	10	$330.32	95%	10%	-$0.02	12
Electric	Energy Efficiency	University	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	15882	10	$741.08	95%	21%	-$0.02	110
Electric	Energy Efficiency	University	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	5148	10	$741.08	95%	10%	-$0.01	6
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	0	3422	10	$327.24	95%	24%	-$0.03	168
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	0	1129	10	$327.24	95%	12%	-$0.01	9
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	1914	30	$3,566.04	10%	95%	$0.15	77
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	3277	30	$9,922.89	10%	95%	$0.28	3
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	438	30	$5,271.54	10%	95%	$1.25	10
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	2306	30	$5,426.58	10%	95%	$0.22	18
Electric	Energy Efficiency	Office	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	5408	30	$4,806.40	10%	95%	$0.06	891
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	333	30	$3,721.09	10%	95%	$1.13	37

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	894	30	$1,085.31	10%	95%	$0.08	11
Electric	Energy Efficiency	School	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	2513	30	$16,589.84	10%	95%	$0.67	6
Electric	Energy Efficiency	University	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	3174	30	$17,365.07	10%	95%	$0.55	3
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	0	355	30	$18,760.47	10%	95%	$5.55	2
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	3484	7	$3,105.00	90%	85%	$0.11	2,556
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	10287	7	$8,640.00	90%	85%	$0.11	92
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	3218	7	$4,590.00	90%	85%	$0.18	1,744
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	10538	7	$4,725.00	90%	85%	$0.05	1,826
Electric	Energy Efficiency	Office	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	7467	7	$4,185.00	90%	85%	$0.03	26,419
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	4708	7	$3,240.00	90%	85%	$0.08	11,074
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	711	7	$945.00	90%	85%	$0.20	59
Electric	Energy Efficiency	School	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	45519	7	$14,445.00	90%	85%	$0.03	2,265
Electric	Energy Efficiency	University	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	47646	7	$15,120.00	90%	85%	$0.03	1,143
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	0	10267	7	$16,335.00	90%	85%	$0.27	1,374
Electric	Energy Efficiency	School	Space Heat	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	2871	45	$8,149.30	15%	60%	$0.25	15
Electric	Energy Efficiency	School	Space Heat	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	930	45	$8,149.30	80%	60%	$0.84	11
Electric	Energy Efficiency	University	Space Heat	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	0	3005	45	$8,530.11	15%	60%	$0.25	7
Electric	Energy Efficiency	University	Space Heat	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	0	974	45	$8,530.11	80%	60%	$0.84	5
Electric	Energy Efficiency	Dry Goods Retail	Space Heat	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	363	45	$16,787.65	15%	80%	$4.44	35
Electric	Energy Efficiency	Grocery	Space Heat	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	514	45	$33,177.25	15%	85%	$6.19	2
Electric	Energy Efficiency	Hospital	Space Heat	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	278	45	$22,972.46	15%	60%	$7.60	14
Electric	Energy Efficiency	Hotel Motel	Space Heat	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	527	45	$48,690.05	15%	50%	$8.97	7
Electric	Energy Efficiency	Other Commercial	Space Heat	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	235	45	$8,963.15	15%	70%	$3.60	61
Electric	Energy Efficiency	Restaurant	Space Heat	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	36	45	$7,446.57	15%	80%	$20.47	1
Electric	Energy Efficiency	School	Space Heat	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	38947	45	$73,539.29	15%	60%	$0.16	213
Electric	Energy Efficiency	University	Space Heat	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	40767	45	$76,975.70	15%	60%	$0.16	106
Electric	Energy Efficiency	Warehouse	Space Heat	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	0	513	45	$22,232.39	15%	98%	$4.24	11

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Fluorescent	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	Existing	0	32796	9	$0.00	10%	75%	-$0.02	4,787
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Other	Retrofit	Bi-Level Control, Stairwell Lighting	Occupancy Sensor Control, 50% Lighting Power during unoccupied Time	Continuous Full Power Lighting in Stairways	New	0	1390	9	$0.00	10%	75%	-$0.02	50
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Fluorescent	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	Existing	0	15139	8	$3,899.38	30%	78%	$0.03	6,134
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Other	Retrofit	Dimming-Continuous, Fluorescent Fixtures	Continuous Dimming, Fluorescent Fixtures (Day-Lighting)	No Dimming Controls	New	0	12830	8	$3,899.38	30%	78%	$0.04	1,591
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Fluorescent	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	18038	8	$1,079.38	90%	42%	-$0.01	12,589
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior HID	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	977	8	$1,079.38	90%	42%	$0.18	441
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Other	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	New	0	6237	8	$1,079.38	90%	42%	$0.01	1,272
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Screw Base	Retrofit	Occupancy Sensor Control	Occupancy Sensor Control	No Occupancy Sensor	Existing	0	2138	8	$1,079.38	90%	42%	$0.07	752
Electric	Energy Efficiency	Multifamily Common Area	Lighting Interior Other	Retrofit	Exit Sign - LED	Two Sided LED Exit Sign (5 Watts)	CFL Exit Sign (9 Watts)	Existing	0	57	16	$26.16	95%	50%	$0.04	61
Electric	Fuel Conversion	Commercial	Water Heating	Existing	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 50 gal.	Existing	Per installation	1514	30	$0.00			$0.76	6
Electric	Fuel Conversion	Commercial	Water Heating	Existing	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 50 gal.	Existing	Per installation	1514	30	-$2,787.60			$0.76	5,326
Electric	Fuel Conversion	Commercial	Space Heating: Ducted	Main	94% Furnace	Furnace - Premium Efficiency	Electric Furnace	Existing	Per installation	76176	30	$7,305.13			$0.04	16,182
Electric	Fuel Conversion	Commercial	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 50 gal.	Existing	Per installation	1514	30	$0.00			$0.76	10
Electric	Fuel Conversion	Commercial	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 50 gal.	Existing	Per installation	1514	30	-$2,787.60			$0.76	5,823
Electric	Fuel Conversion	Commercial	Space Heating: Ducted	Main Ext - Short (ft)	94% Furnace	Furnace - Premium Efficiency	Electric Furnace	Existing	Per installation	76176	30	$7,305.13			$0.04	6,037
Electric	Fuel Conversion	Commercial	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 50 gal.	Existing	Per installation	1514	30	$0.00			$0.76	4
Electric	Fuel Conversion	Commercial	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 50 gal.	Existing	Per installation	1514	30	-$2,787.60			$0.76	2,172
Electric	Fuel Conversion	Commercial	Space Heating: Ducted	Main Ext - Medium (ft)	94% Furnace	Furnace - Premium Efficiency	Electric Furnace	Existing	Per installation	76176	30	$7,305.13			$0.04	12,073
Electric	Fuel Conversion	Commercial	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 50 gal.	Existing	Per installation	1514	30	$0.00			$0.76	7
Electric	Fuel Conversion	Commercial	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 50 gal.	Existing	Per installation	1514	30	-$2,787.60			$0.76	4,345
Electric	Fuel Conversion	Commercial	Water Heating	Main	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 50 gal.	New	Per installation	1598	30	$0.00			$0.76	3
Electric	Fuel Conversion	Commercial	Water Heating	Main	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 50 gal.	New	Per installation	1598	30	-$2,787.60			$0.77	1,675
Electric	Fuel Conversion	Commercial	Space Heating	Main	Gas warm up heat	Gas warm up heat	Electric Furnace	New	Per installation	22469	30	$6,900.24			$0.06	458
Electric	Fuel Conversion	Commercial	Space Heating	Main	94% Furnace	Furnace - Premium Efficiency	Electric Furnace	New	Per installation	22469	30	$2,964.98			$0.11	632
Electric	Fuel Conversion	Commercial	Space Heating, Water Heating	Main	Boiler	Integrated Space Heating and Water Heating	Packaged Rooftop Unit, Electric Water Heater, 50 gal.	New	Per installation	56928	30	-$18,062.08			$0.04	2,898

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Fuel Conversion	Commercial	Space Heating, Water Heating	Main	Boiler	Integrated Space Heating and Water Heating	Packaged Rooftop VAV w/ Electrical Resistance Reheat & Electric Water Heater, 50 gal.	New	Per installation	56928	30	-$18,062.08			$0.04	6,464
Electric	Fuel Conversion	Commercial	Space Heating	Main	Gas PACs	Gas PACs	Packaged Rooftop Unit	New	Per installation	37290	30	$1,293.97			$0.05	11,007
Electric	Fuel Conversion	Commercial	Water Heating	Main Ext - Short (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 50 gal.	New	Per installation	1598	30	$0.00			$0.76	1
Electric	Fuel Conversion	Commercial	Water Heating	Main Ext - Short (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 50 gal.	New	Per installation	1598	30	-$2,787.60			$0.77	625
Electric	Fuel Conversion	Commercial	Space Heating	Main Ext - Short (ft)	Gas warm up heat	Gas warm up heat	Electric Furnace	New	Per installation	22469	30	$6,900.24			$0.06	171
Electric	Fuel Conversion	Commercial	Space Heating	Main Ext - Short (ft)	94% Furnace	Furnace - Premium Efficiency	Electric Furnace	New	Per installation	22469	30	$2,964.98			$0.11	236
Electric	Fuel Conversion	Commercial	Space Heating, Water Heating	Main Ext - Short (ft)	Boiler	Integrated Space Heating and Water Heating	Packaged Rooftop Unit, Electric Water Heater, 50 gal.	New	Per installation	56928	30	-$18,062.08			$0.04	1,081
Electric	Fuel Conversion	Commercial	Space Heating, Water Heating	Main Ext - Short (ft)	Boiler	Integrated Space Heating and Water Heating	Packaged Rooftop VAV w/ Electrical Resistance Reheat & Electric Water Heater, 50 gal.	New	Per installation	56928	30	-$18,062.08			$0.04	2,411
Electric	Fuel Conversion	Commercial	Space Heating	Main Ext - Short (ft)	Gas PACs	Gas PACs	Packaged Rooftop Unit	New	Per installation	37290	30	$1,293.97			$0.05	4,106
Electric	Fuel Conversion	Commercial	Water Heating	Main Ext - Medium (ft)	Tankless WH	Water Heater - ENERGY STAR Tankless	Electric Water Heater, 50 gal.	New	Per installation	1598	30	$0.00			$0.76	2
Electric	Fuel Conversion	Commercial	Water Heating	Main Ext - Medium (ft)	WH (>67% EF)	Water Heater - ENERGY STAR Storage	Electric Water Heater, 50 gal.	New	Per installation	1598	30	-$2,787.60			$0.77	1,250
Electric	Fuel Conversion	Commercial	Space Heating	Main Ext - Medium (ft)	Gas warm up heat	Gas warm up heat	Electric Furnace	New	Per installation	22469	30	$6,900.24			$0.06	342
Electric	Fuel Conversion	Commercial	Space Heating	Main Ext - Medium (ft)	94% Furnace	Furnace - Premium Efficiency	Electric Furnace	New	Per installation	22469	30	$2,964.98			$0.11	471
Electric	Fuel Conversion	Commercial	Space Heating, Water Heating	Main Ext - Medium (ft)	Boiler	Integrated Space Heating and Water Heating	Packaged Rooftop Unit, Electric Water Heater, 50 gal.	New	Per installation	56928	30	-$18,062.08			$0.04	2,162
Electric	Fuel Conversion	Commercial	Space Heating, Water Heating	Main Ext - Medium (ft)	Boiler	Integrated Space Heating and Water Heating	Packaged Rooftop VAV w/ Electrical Resistance Reheat & Electric Water Heater, 50 gal.	New	Per installation	56928	30	-$18,062.08			$0.04	4,823
Electric	Fuel Conversion	Commercial	Space Heating	Main Ext - Medium (ft)	Gas PACs	Gas PACs	Packaged Rooftop Unit	New	Per installation	37290	30	$1,293.97			$0.05	8,212

Table 3 – Industrial Electric Measure Detail

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	629797	10	$50,698.65	26%	100%	$0.02	136
Electric	Energy Efficiency	Chemical Mfg	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	510004	10	$12,880.45	20%	100%	-$0.01	83
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	135281	10	$0.00	27%	100%	$0.01	31
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	473485	10	$40,584.39	23%	100%	$0.03	86
Electric	Energy Efficiency	Chemical Mfg	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	371574	10	$29,365.72	51%	100%	$0.00	137
Electric	Energy Efficiency	Chemical Mfg	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	205498	10	$43,771.02	15%	100%	$0.02	17
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	14779	10	$1,625.65	8%	100%	$0.00	1
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	6764	10	$744.05	8%	100%	$0.00	0
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	15745	10	$1,731.94	8%	100%	$0.00	1
Electric	Energy Efficiency	Chemical Mfg	Motors Other	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	15177	10	$1,669.42	8%	100%	$0.00	1
Electric	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	959	10	$105.53	8%	100%	$0.00	0
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	14779	10	$2,216.79	11%	100%	$0.01	1
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	6764	10	$1,014.61	11%	100%	$0.01	1
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	15745	10	$2,361.74	11%	100%	$0.01	1
Electric	Energy Efficiency	Chemical Mfg	Motors Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	15177	10	$2,276.48	11%	100%	$0.01	1
Electric	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	959	10	$143.91	11%	100%	$0.01	0
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	14779	10	$3,399.08	10%	100%	$0.02	1
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	6764	10	$1,555.73	10%	100%	$0.02	1
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	15745	10	$3,621.33	10%	100%	$0.02	1
Electric	Energy Efficiency	Chemical Mfg	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	15177	10	$3,490.60	10%	100%	$0.02	1
Electric	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	959	10	$220.66	10%	100%	$0.02	0
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	26602	10	$9,576.55	6%	100%	$0.04	1
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	12175	10	$4,383.11	6%	100%	$0.04	1
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	28341	10	$10,202.71	6%	100%	$0.04	1
Electric	Energy Efficiency	Chemical Mfg	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	27318	10	$9,834.38	6%	100%	$0.04	1
Electric	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	1727	10	$621.69	6%	100%	$0.04	0
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	14779	10	$4,581.37	6%	100%	$0.03	1
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	6764	10	$2,096.86	6%	100%	$0.03	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	15745	10	$4,880.93	6%	100%	$0.03	1
Electric	Energy Efficiency	Chemical Mfg	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	15177	10	$4,704.72	6%	100%	$0.03	1
Electric	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	959	10	$297.41	6%	100%	$0.03	0
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	354687	10	$7,423.60	27%	100%	$0.02	74
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	162338	10	$3,397.72	27%	100%	$0.02	36
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	377878	10	$7,908.99	27%	100%	$0.02	85
Electric	Energy Efficiency	Chemical Mfg	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	364236	10	$7,623.47	27%	100%	$0.02	82
Electric	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	23026	10	$481.93	27%	100%	$0.02	5
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	221679	10	$0.00	31%	100%	$0.01	51
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	591145	10	$73,893.14	34%	100%	$0.03	143
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Pump System Optimization	Pump System Optimization		Existing	Per Industry	1477863	12	$375,377.15	15%	100%	-$0.03	190
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	59115	10	$12,646.39	21%	100%	$0.02	9
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	27056	10	$5,788.15	21%	100%	$0.02	4
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	62980	10	$13,473.27	21%	100%	$0.02	10
Electric	Energy Efficiency	Chemical Mfg	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	60706	10	$12,986.87	21%	100%	$0.02	10
Electric	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	3838	10	$820.98	21%	100%	$0.02	1
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	44336	10	$4,406.01	9%	100%	$0.00	3
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	20292	10	$2,016.60	9%	100%	$0.00	2
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	47235	10	$4,694.09	9%	100%	$0.00	4
Electric	Energy Efficiency	Chemical Mfg	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	45530	10	$4,524.63	9%	100%	$0.00	4
Electric	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	2878	10	$286.03	9%	100%	$0.00	0
Electric	Energy Efficiency	Chemical Mfg	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	13710	10	$1,362.51	9%	100%	$0.00	1
Electric	Energy Efficiency	Chemical Mfg	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	18302	10	$1,818.83	9%	100%	$0.00	1
Electric	Energy Efficiency	Chemical Mfg	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	10929	10	$1,086.07	9%	100%	$0.00	1
Electric	Energy Efficiency	Chemical Mfg	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	7177	10	$713.23	9%	100%	$0.00	1
Electric	Energy Efficiency	Chemical Mfg	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	12118	32	$9,210.04	37%	100%	$0.06	3
Electric	Energy Efficiency	Chemical Mfg	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	5547	32	$4,215.36	37%	100%	$0.06	1
Electric	Energy Efficiency	Chemical Mfg	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	12911	32	$9,812.24	37%	100%	$0.06	4
Electric	Energy Efficiency	Chemical Mfg	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	12445	32	$9,458.00	37%	100%	$0.06	4

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	787	32	$597.90	37%	100%	$0.06	0
Electric	Energy Efficiency	Chemical Mfg	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	3748	32	$2,848.11	37%	100%	$0.06	1
Electric	Energy Efficiency	Chemical Mfg	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	5003	32	$3,801.98	37%	100%	$0.06	2
Electric	Energy Efficiency	Chemical Mfg	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	2987	32	$2,270.25	37%	100%	$0.06	1
Electric	Energy Efficiency	Chemical Mfg	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1962	32	$1,490.90	37%	100%	$0.06	1
Electric	Energy Efficiency	Fabricated Metal Products	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	841446	10	$67,736.38	26%	100%	$0.02	182
Electric	Energy Efficiency	Fabricated Metal Products	Lighting	Retrofit	Efficient Lighting 1 Shift	Efficient Lighting 1 Shift		Existing	Per Industry	3592512	10	$277,903.32	1%	100%	$0.00	34
Electric	Energy Efficiency	Fabricated Metal Products	Lighting	Retrofit	Efficient Lighting 2 Shift	Efficient Lighting 2 Shift		Existing	Per Industry	3592512	10	$162,603.00	3%	100%	-$0.01	86
Electric	Energy Efficiency	Fabricated Metal Products	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	3592512	10	$90,730.99	15%	100%	-$0.01	463
Electric	Energy Efficiency	Fabricated Metal Products	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	364804	10	$0.00	27%	100%	$0.01	83
Electric	Energy Efficiency	Fabricated Metal Products	Lighting	Retrofit	HighBay Lighting 1 Shift	HighBay Lighting 1 Shift		Existing	Per Industry	2617401	10	$633,582.91	2%	100%	$0.02	31
Electric	Energy Efficiency	Fabricated Metal Products	Lighting	Retrofit	HighBay Lighting 2 Shift	HighBay Lighting 2 Shift		Existing	Per Industry	2617401	10	$370,713.41	4%	100%	$0.01	71
Electric	Energy Efficiency	Fabricated Metal Products	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	2617401	10	$206,854.70	23%	100%	$0.00	438
Electric	Energy Efficiency	Fabricated Metal Products	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	1447544	10	$308,326.86	15%	100%	$0.02	137
Electric	Energy Efficiency	Fabricated Metal Products	Fans	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	18240	10	$2,736.03	4%	100%	$0.01	1
Electric	Energy Efficiency	Fabricated Metal Products	Process Aircomp	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	21036	10	$3,155.42	4%	100%	$0.01	1
Electric	Energy Efficiency	Fabricated Metal Products	Motors Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	51925	10	$7,788.70	4%	100%	$0.01	2
Electric	Energy Efficiency	Fabricated Metal Products	Process Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	7926	10	$1,188.91	4%	100%	$0.01	0
Electric	Energy Efficiency	Fabricated Metal Products	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	18240	10	$4,195.25	13%	100%	$0.02	2
Electric	Energy Efficiency	Fabricated Metal Products	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	21036	10	$4,838.31	13%	100%	$0.02	2
Electric	Energy Efficiency	Fabricated Metal Products	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	51925	10	$11,942.67	13%	100%	$0.02	6
Electric	Energy Efficiency	Fabricated Metal Products	Process Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	7926	10	$1,823.00	13%	100%	$0.02	1
Electric	Energy Efficiency	Fabricated Metal Products	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	32832	10	$11,819.65	20%	100%	$0.04	5
Electric	Energy Efficiency	Fabricated Metal Products	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	37865	10	$13,631.42	20%	100%	$0.04	6
Electric	Energy Efficiency	Fabricated Metal Products	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	93464	10	$33,647.18	20%	100%	$0.04	15
Electric	Energy Efficiency	Fabricated Metal Products	Process Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	14267	10	$5,136.11	20%	100%	$0.04	2
Electric	Energy Efficiency	Fabricated Metal Products	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	18240	10	$5,654.46	5%	100%	$0.03	1
Electric	Energy Efficiency	Fabricated Metal Products	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	21036	10	$6,521.20	5%	100%	$0.03	1
Electric	Energy Efficiency	Fabricated Metal Products	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	51925	10	$16,096.64	5%	100%	$0.03	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Fabricated Metal Products	Process Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	7926	10	$2,457.09	5%	100%	$0.03	0
Electric	Energy Efficiency	Fabricated Metal Products	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	437765	10	$9,162.42	27%	100%	$0.02	96
Electric	Energy Efficiency	Fabricated Metal Products	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	504867	10	$10,566.87	27%	100%	$0.02	114
Electric	Energy Efficiency	Fabricated Metal Products	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	1246192	10	$26,082.79	27%	100%	$0.02	280
Electric	Energy Efficiency	Fabricated Metal Products	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	190226	10	$3,981.43	27%	100%	$0.02	43
Electric	Energy Efficiency	Fabricated Metal Products	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	72961	10	$15,608.53	21%	100%	$0.02	12
Electric	Energy Efficiency	Fabricated Metal Products	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	84145	10	$18,001.08	21%	100%	$0.02	13
Electric	Energy Efficiency	Fabricated Metal Products	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	207699	10	$44,433.04	21%	100%	$0.02	35
Electric	Energy Efficiency	Fabricated Metal Products	Process Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	31704	10	$6,782.52	21%	100%	$0.02	5
Electric	Energy Efficiency	Fabricated Metal Products	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	54721	10	$5,438.02	9%	100%	$0.00	4
Electric	Energy Efficiency	Fabricated Metal Products	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	63108	10	$6,271.58	9%	100%	$0.00	5
Electric	Energy Efficiency	Fabricated Metal Products	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	155774	10	$15,480.49	9%	100%	$0.00	12
Electric	Energy Efficiency	Fabricated Metal Products	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	23778	10	$2,363.03	9%	100%	$0.00	2
Electric	Energy Efficiency	Fabricated Metal Products	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	161073	10	$16,007.09	9%	100%	$0.00	13
Electric	Energy Efficiency	Fabricated Metal Products	Process Electro Chemical	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	15015	10	$1,492.14	9%	100%	$0.00	1
Electric	Energy Efficiency	Fabricated Metal Products	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	82221	10	$8,170.95	9%	100%	$0.00	6
Electric	Energy Efficiency	Fabricated Metal Products	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	76982	10	$7,650.35	9%	100%	$0.00	5
Electric	Energy Efficiency	Fabricated Metal Products	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	26232	10	$2,606.89	9%	100%	$0.00	2
Electric	Energy Efficiency	Fabricated Metal Products	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	14957	32	$11,367.29	37%	100%	$0.06	4
Electric	Energy Efficiency	Fabricated Metal Products	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	17250	32	$13,109.72	37%	100%	$0.06	5
Electric	Energy Efficiency	Fabricated Metal Products	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	42578	32	$32,359.44	37%	100%	$0.06	13
Electric	Energy Efficiency	Fabricated Metal Products	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	6499	32	$4,939.54	37%	100%	$0.06	2
Electric	Energy Efficiency	Fabricated Metal Products	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	44027	32	$33,460.22	37%	100%	$0.06	14
Electric	Energy Efficiency	Fabricated Metal Products	Process Electro Chemical	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	4104	32	$3,119.07	37%	100%	$0.06	1
Electric	Energy Efficiency	Fabricated Metal Products	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	22474	32	$17,080.05	37%	100%	$0.06	7
Electric	Energy Efficiency	Fabricated Metal Products	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	21042	32	$15,991.81	37%	100%	$0.06	5
Electric	Energy Efficiency	Fabricated Metal Products	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	7170	32	$5,449.27	37%	100%	$0.06	2
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	398361	10	$32,068.08	26%	100%	$0.02	86
Electric	Energy Efficiency	Food Mfg	Lighting	Retrofit	Efficient Lighting 1 Shift	Efficient Lighting 1 Shift		Existing	Per Industry	2969896	10	$229,740.08	4%	100%	$0.00	99

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Food Mfg	Lighting	Retrofit	Efficient Lighting 2 Shift	Efficient Lighting 2 Shift		Existing	Per Industry	2969896	10	$134,422.39	3%	100%	-$0.01	83
Electric	Energy Efficiency	Food Mfg	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	2969896	10	$75,006.46	12%	100%	-$0.01	292
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	1230264	11	$151,431.39	27%	100%	$0.03	232
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	562621	11	$69,252.16	27%	100%	$0.03	105
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	577624	11	$71,098.88	27%	100%	$0.03	105
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	2925627	11	$360,111.23	27%	100%	$0.03	564
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	2205473	11	$271,468.47	27%	100%	$0.03	425
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	194007	10	$0.00	27%	100%	$0.01	39
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	679025	10	$58,202.13	23%	100%	$0.03	101
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Food: Cooling and Storage	Food: Cooling and Storage		Existing	Per Industry	1140762	10	$342,228.50	100%	100%	$0.03	750
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Food: Refrig Storage Tuneup	Food: Refrig Storage Tuneup		Existing	Per Industry	570381	3	$39,926.66	100%	100%	$0.01	476
Electric	Energy Efficiency	Food Mfg	Lighting	Retrofit	HighBay Lighting 1 Shift	HighBay Lighting 1 Shift		Existing	Per Industry	2163781	10	$523,777.09	7%	100%	$0.02	93
Electric	Energy Efficiency	Food Mfg	Lighting	Retrofit	HighBay Lighting 2 Shift	HighBay Lighting 2 Shift		Existing	Per Industry	2163781	10	$306,465.32	5%	100%	$0.01	71
Electric	Energy Efficiency	Food Mfg	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	2163781	10	$171,004.85	18%	100%	$0.00	277
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	2121144	11	$418,145.39	22%	100%	-$0.02	390
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	970035	11	$191,225.03	22%	100%	-$0.02	178
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	995903	11	$196,324.36	22%	100%	-$0.02	183
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	5044184	11	$994,370.14	22%	100%	-$0.02	926
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	3802539	11	$749,602.11	22%	100%	-$0.02	698
Electric	Energy Efficiency	Food Mfg	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	1196671	10	$254,890.94	15%	100%	$0.02	114
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	21211	10	$2,333.26	11%	100%	$0.00	2
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	9700	10	$1,067.04	11%	100%	$0.00	1
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	9959	10	$1,095.49	11%	100%	$0.00	1
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	50442	10	$5,548.60	11%	100%	$0.00	5
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	38025	10	$4,182.79	11%	100%	$0.00	4
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	21211	10	$3,181.72	10%	100%	$0.01	2
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	9700	10	$1,455.05	10%	100%	$0.01	1
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	9959	10	$1,493.85	10%	100%	$0.01	1
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	50442	10	$7,566.28	10%	100%	$0.01	4

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	38025	10	$5,703.81	10%	100%	$0.01	3
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	21211	10	$4,878.63	12%	100%	$0.02	2
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	9700	10	$2,231.08	12%	100%	$0.02	1
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	9959	10	$2,290.58	12%	100%	$0.02	1
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	50442	10	$11,601.62	12%	100%	$0.02	4
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	38025	10	$8,745.84	12%	100%	$0.02	3
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	38181	10	$13,745.01	12%	100%	$0.04	3
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	17461	10	$6,285.83	12%	100%	$0.04	1
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	17926	10	$6,453.45	12%	100%	$0.04	1
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	90795	10	$32,686.31	12%	100%	$0.04	7
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	68446	10	$24,640.45	12%	100%	$0.04	5
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	21211	10	$6,575.55	11%	100%	$0.03	1
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	9700	10	$3,007.11	11%	100%	$0.03	1
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	9959	10	$3,087.30	11%	100%	$0.03	1
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	50442	10	$15,636.97	11%	100%	$0.03	4
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	38025	10	$11,787.87	11%	100%	$0.03	2
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	509075	10	$10,654.93	27%	100%	$0.02	102
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	232809	10	$4,872.68	27%	100%	$0.02	45
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	239017	10	$5,002.62	27%	100%	$0.02	48
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	1210604	10	$25,337.95	27%	100%	$0.02	242
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	912609	10	$19,100.91	27%	100%	$0.02	183
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	318172	10	$0.00	31%	100%	$0.01	71
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	848458	10	$106,057.21	34%	100%	$0.03	183
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	84846	10	$18,151.08	21%	100%	$0.02	12
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	38801	10	$8,300.80	21%	100%	$0.02	6
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	39836	10	$8,522.16	21%	100%	$0.02	6
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	201767	10	$43,164.16	21%	100%	$0.02	30
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	152102	10	$32,539.14	21%	100%	$0.02	23
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	63634	10	$6,323.84	9%	100%	$0.00	4

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	29101	10	$2,892.00	9%	100%	$0.00	2
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	29877	10	$2,969.12	9%	100%	$0.00	2
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	151326	10	$15,038.41	9%	100%	$0.00	11
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	114076	10	$11,336.65	9%	100%	$0.00	8
Electric	Energy Efficiency	Food Mfg	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	72602	10	$7,214.99	9%	100%	$0.00	6
Electric	Energy Efficiency	Food Mfg	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	63641	10	$6,324.47	9%	100%	$0.00	4
Electric	Energy Efficiency	Food Mfg	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	37239	10	$3,700.73	9%	100%	$0.00	3
Electric	Energy Efficiency	Food Mfg	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	17393	32	$13,218.97	37%	100%	$0.06	4
Electric	Energy Efficiency	Food Mfg	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	7954	32	$6,045.26	37%	100%	$0.06	2
Electric	Energy Efficiency	Food Mfg	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	8166	32	$6,206.47	37%	100%	$0.06	2
Electric	Energy Efficiency	Food Mfg	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	41362	32	$31,435.36	37%	100%	$0.06	10
Electric	Energy Efficiency	Food Mfg	Process Refrig	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	31181	32	$23,697.42	37%	100%	$0.06	6
Electric	Energy Efficiency	Food Mfg	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	19844	32	$15,081.76	37%	100%	$0.06	6
Electric	Energy Efficiency	Food Mfg	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	17395	32	$13,220.28	37%	100%	$0.06	4
Electric	Energy Efficiency	Food Mfg	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	10179	32	$7,735.78	37%	100%	$0.06	3
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	1161583	10	$93,507.43	26%	100%	$0.02	252
Electric	Energy Efficiency	Industrial Machinery	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	8259179	10	$208,590.41	15%	100%	-$0.01	1,066
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	503598	10	$0.00	27%	100%	$0.01	97
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	1762592	10	$151,079.31	23%	100%	$0.03	272
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	2517989	10	$302,158.63	30%	100%	$0.00	622
Electric	Energy Efficiency	Industrial Machinery	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	6017402	10	$475,558.64	23%	100%	$0.00	1,039
Electric	Energy Efficiency	Industrial Machinery	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	3327901	10	$708,843.00	15%	100%	$0.02	335
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	45581	10	$5,013.92	17%	100%	$0.00	7
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	25180	10	$2,769.79	17%	100%	$0.00	4
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	29040	10	$3,194.35	17%	100%	$0.00	4
Electric	Energy Efficiency	Industrial Machinery	Motors Other	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	71680	10	$7,884.80	17%	100%	$0.00	10
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	45581	10	$6,837.17	20%	100%	$0.01	8
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	25180	10	$3,776.98	20%	100%	$0.01	4
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	29040	10	$4,355.94	20%	100%	$0.01	5

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Industrial Machinery	Motors Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	71680	10	$10,751.99	20%	100%	$0.01	12
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	45581	10	$10,483.65	4%	100%	$0.02	1
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	25180	10	$5,791.37	4%	100%	$0.02	1
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	29040	10	$6,679.10	4%	100%	$0.02	1
Electric	Energy Efficiency	Industrial Machinery	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	71680	10	$16,486.39	4%	100%	$0.02	2
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	82046	10	$29,536.56	13%	100%	$0.04	8
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	45324	10	$16,316.57	13%	100%	$0.04	4
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	52271	10	$18,817.65	13%	100%	$0.04	5
Electric	Energy Efficiency	Industrial Machinery	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	129024	10	$46,448.62	13%	100%	$0.04	13
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	45581	10	$14,130.14	7%	100%	$0.03	3
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	25180	10	$7,805.76	7%	100%	$0.03	1
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	29040	10	$9,002.27	7%	100%	$0.03	2
Electric	Energy Efficiency	Industrial Machinery	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	71680	10	$22,220.79	7%	100%	$0.03	4
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	1093947	10	$22,896.30	27%	100%	$0.02	246
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	604317	10	$12,648.36	27%	100%	$0.02	112
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	696950	10	$14,587.16	27%	100%	$0.02	157
Electric	Energy Efficiency	Industrial Machinery	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	1720319	10	$36,006.28	27%	100%	$0.02	387
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	683717	10	$0.00	31%	100%	$0.01	171
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	1823244	10	$227,905.53	34%	100%	$0.03	479
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	182324	10	$39,004.73	21%	100%	$0.02	30
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	100720	10	$21,546.97	21%	100%	$0.02	14
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	116158	10	$24,849.79	21%	100%	$0.02	19
Electric	Energy Efficiency	Industrial Machinery	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	286720	10	$61,338.08	21%	100%	$0.02	48
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	136743	10	$13,589.26	9%	100%	$0.00	11
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	75540	10	$7,506.97	9%	100%	$0.00	5
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	87119	10	$8,657.67	9%	100%	$0.00	7
Electric	Energy Efficiency	Industrial Machinery	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	215040	10	$21,370.21	9%	100%	$0.00	17
Electric	Energy Efficiency	Industrial Machinery	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	83496	10	$8,297.64	9%	100%	$0.00	7
Electric	Energy Efficiency	Industrial Machinery	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	273356	10	$27,165.54	9%	100%	$0.00	21

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Industrial Machinery	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	176982	10	$17,588.14	9%	100%	$0.00	11
Electric	Energy Efficiency	Industrial Machinery	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	45167	10	$4,488.58	9%	100%	$0.00	4
Electric	Energy Efficiency	Industrial Machinery	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	37377	32	$28,406.15	37%	100%	$0.06	10
Electric	Energy Efficiency	Industrial Machinery	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	20648	32	$15,692.10	37%	100%	$0.06	5
Electric	Energy Efficiency	Industrial Machinery	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	23812	32	$18,097.46	37%	100%	$0.06	7
Electric	Energy Efficiency	Industrial Machinery	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	58778	32	$44,670.95	37%	100%	$0.06	18
Electric	Energy Efficiency	Industrial Machinery	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	22822	32	$17,344.88	37%	100%	$0.06	7
Electric	Energy Efficiency	Industrial Machinery	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	74717	32	$56,785.15	37%	100%	$0.06	23
Electric	Energy Efficiency	Industrial Machinery	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	48375	32	$36,765.15	37%	100%	$0.06	11
Electric	Energy Efficiency	Industrial Machinery	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	12346	32	$9,382.65	37%	100%	$0.06	4
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	1388502	10	$111,774.42	26%	100%	$0.02	301
Electric	Energy Efficiency	Miscellaneous Mfg	Hvac	Retrofit	Clean Room: Change Filter Strategy	Clean Room: Change Filter Strategy		Existing	Per Industry	14605993	1	$94,748.37	10%	100%	-$0.01	1,219
Electric	Energy Efficiency	Miscellaneous Mfg	Hvac	Retrofit	Clean Room: Chiller Optimize	Clean Room: Chiller Optimize		Existing	Per Industry	5412555	10	$440,766.20	28%	100%	$0.00	1,230
Electric	Energy Efficiency	Miscellaneous Mfg	Hvac	Retrofit	Clean Room: Clean Room HVAC	Clean Room: Clean Room HVAC		Existing	Per Industry	3286348	20	$532,055.24	30%	100%	$0.00	757
Electric	Energy Efficiency	Miscellaneous Mfg	Lighting	Retrofit	Efficient Lighting 1 Shift	Efficient Lighting 1 Shift		Existing	Per Industry	17307918	10	###########	5%	100%	$0.00	658
Electric	Energy Efficiency	Miscellaneous Mfg	Lighting	Retrofit	Efficient Lighting 2 Shift	Efficient Lighting 2 Shift		Existing	Per Industry	17307918	10	$783,384.90	3%	100%	-$0.01	414
Electric	Energy Efficiency	Miscellaneous Mfg	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	17307918	10	$437,121.62	15%	100%	-$0.01	2,233
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	742800	10	$0.00	27%	100%	$0.01	143
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	2599800	10	$222,840.02	23%	100%	$0.03	401
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	3714000	10	$445,680.03	30%	100%	$0.00	918
Electric	Energy Efficiency	Miscellaneous Mfg	Lighting	Retrofit	HighBay Lighting 1 Shift	HighBay Lighting 1 Shift		Existing	Per Industry	12610054	10	###########	8%	100%	$0.02	597
Electric	Energy Efficiency	Miscellaneous Mfg	Lighting	Retrofit	HighBay Lighting 2 Shift	HighBay Lighting 2 Shift		Existing	Per Industry	12610054	10	###########	4%	100%	$0.01	334
Electric	Energy Efficiency	Miscellaneous Mfg	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	12610054	10	$996,579.65	23%	100%	$0.00	2,050
Electric	Energy Efficiency	Miscellaneous Mfg	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	6973943	10	###########	15%	100%	$0.02	621
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	21119	10	$2,323.07	17%	100%	$0.00	3
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	37140	10	$4,085.40	17%	100%	$0.00	5
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	34713	10	$3,818.38	17%	100%	$0.00	5
Electric	Energy Efficiency	Miscellaneous Mfg	Motors Other	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	149531	10	$16,448.41	17%	100%	$0.00	22
Electric	Energy Efficiency	Miscellaneous Mfg	Process Other	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	6346	10	$698.04	17%	100%	$0.00	1

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	21119	10	$3,167.82	20%	100%	$0.01	4
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	37140	10	$5,571.00	20%	100%	$0.01	6
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	34713	10	$5,206.88	20%	100%	$0.01	6
Electric	Energy Efficiency	Miscellaneous Mfg	Motors Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	149531	10	$22,429.65	20%	100%	$0.01	25
Electric	Energy Efficiency	Miscellaneous Mfg	Process Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	6346	10	$951.87	20%	100%	$0.01	1
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	21119	10	$4,857.33	4%	100%	$0.02	1
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	37140	10	$8,542.20	4%	100%	$0.02	1
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	34713	10	$7,983.89	4%	100%	$0.02	1
Electric	Energy Efficiency	Miscellaneous Mfg	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	149531	10	$34,392.13	4%	100%	$0.02	5
Electric	Energy Efficiency	Miscellaneous Mfg	Process Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	6346	10	$1,459.53	4%	100%	$0.02	0
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	38014	10	$13,685.00	11%	100%	$0.04	3
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	66852	10	$24,066.72	11%	100%	$0.04	5
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	62483	10	$22,493.73	11%	100%	$0.04	5
Electric	Energy Efficiency	Miscellaneous Mfg	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	269156	10	$96,896.08	11%	100%	$0.04	25
Electric	Energy Efficiency	Miscellaneous Mfg	Process Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	11422	10	$4,112.06	11%	100%	$0.04	1
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	21119	10	$6,546.84	7%	100%	$0.03	1
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	37140	10	$11,513.40	7%	100%	$0.03	2
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	34713	10	$10,760.89	7%	100%	$0.03	2
Electric	Energy Efficiency	Miscellaneous Mfg	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	149531	10	$46,354.61	7%	100%	$0.03	9
Electric	Energy Efficiency	Miscellaneous Mfg	Process Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	6346	10	$1,967.19	7%	100%	$0.03	0
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	506852	10	$10,608.41	27%	100%	$0.02	105
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	891360	10	$18,656.17	27%	100%	$0.02	166
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	833101	10	$17,436.81	27%	100%	$0.02	187
Electric	Energy Efficiency	Miscellaneous Mfg	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	3588744	10	$75,112.41	27%	100%	$0.02	806
Electric	Energy Efficiency	Miscellaneous Mfg	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	152299	10	$3,187.61	27%	100%	$0.02	34
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	316782	10	$0.00	31%	100%	$0.01	73
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	844753	10	$105,594.13	34%	100%	$0.03	205
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Pump System Optimization	Pump System Optimization		Existing	Per Industry	2111883	12	$536,418.16	15%	100%	-$0.03	272
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	84475	10	$18,071.83	21%	100%	$0.02	13

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	148560	10	$31,781.49	21%	100%	$0.02	21
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	138850	10	$29,704.27	21%	100%	$0.02	22
Electric	Energy Efficiency	Miscellaneous Mfg	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	598124	10	$127,956.87	21%	100%	$0.02	101
Electric	Energy Efficiency	Miscellaneous Mfg	Process Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	25383	10	$5,430.22	21%	100%	$0.02	4
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	63356	10	$6,296.23	9%	100%	$0.00	5
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	111420	10	$11,072.68	9%	100%	$0.00	7
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	104138	10	$10,348.98	9%	100%	$0.00	8
Electric	Energy Efficiency	Miscellaneous Mfg	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	448593	10	$44,580.22	9%	100%	$0.00	35
Electric	Energy Efficiency	Miscellaneous Mfg	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	19037	10	$1,891.89	9%	100%	$0.00	1
Electric	Energy Efficiency	Miscellaneous Mfg	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	225466	10	$22,406.36	9%	100%	$0.00	18
Electric	Energy Efficiency	Miscellaneous Mfg	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	547725	10	$54,431.72	9%	100%	$0.00	38
Electric	Energy Efficiency	Miscellaneous Mfg	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	370884	10	$36,857.66	9%	100%	$0.00	21
Electric	Energy Efficiency	Miscellaneous Mfg	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	129591	10	$12,878.53	9%	100%	$0.00	10
Electric	Energy Efficiency	Miscellaneous Mfg	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	17317	32	$13,161.25	37%	100%	$0.06	4
Electric	Energy Efficiency	Miscellaneous Mfg	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	30455	32	$23,145.65	37%	100%	$0.06	7
Electric	Energy Efficiency	Miscellaneous Mfg	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	28464	32	$21,632.86	37%	100%	$0.06	8
Electric	Energy Efficiency	Miscellaneous Mfg	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	122615	32	$93,187.71	37%	100%	$0.06	37
Electric	Energy Efficiency	Miscellaneous Mfg	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	5204	32	$3,954.69	37%	100%	$0.06	2
Electric	Energy Efficiency	Miscellaneous Mfg	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	61627	32	$46,836.86	37%	100%	$0.06	19
Electric	Energy Efficiency	Miscellaneous Mfg	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	149711	32	$113,780.68	37%	100%	$0.06	42
Electric	Energy Efficiency	Miscellaneous Mfg	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	101375	32	$77,044.96	37%	100%	$0.06	21
Electric	Energy Efficiency	Miscellaneous Mfg	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	35422	32	$26,920.47	37%	100%	$0.06	11
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	581620	10	$46,820.40	26%	100%	$0.02	126
Electric	Energy Efficiency	Nonmetallic Mineral Products	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	1195300	10	$30,188.01	13%	100%	-$0.01	126
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	252158	10	$0.00	27%	100%	$0.01	49
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	882553	10	$75,647.39	23%	100%	$0.03	136
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	1260790	10	$151,294.78	30%	100%	$0.00	312
Electric	Energy Efficiency	Nonmetallic Mineral Products	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	870862	10	$68,824.68	19%	100%	$0.00	126
Electric	Energy Efficiency	Nonmetallic Mineral Products	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	481627	10	$102,586.50	15%	100%	$0.02	51

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Nonmetallic Mineral Products	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	22823	10	$5,249.30	17%	100%	$0.02	3
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	12608	10	$2,899.82	17%	100%	$0.02	1
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	14540	10	$3,344.31	17%	100%	$0.02	2
Electric	Energy Efficiency	Nonmetallic Mineral Products	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	35891	10	$8,254.95	17%	100%	$0.02	5
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	5253	10	$1,208.17	17%	100%	$0.02	1
Electric	Energy Efficiency	Nonmetallic Mineral Products	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	41082	10	$14,789.34	11%	100%	$0.04	3
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	22694	10	$8,169.92	11%	100%	$0.04	2
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	26173	10	$9,422.24	11%	100%	$0.04	2
Electric	Energy Efficiency	Nonmetallic Mineral Products	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	64604	10	$23,257.43	11%	100%	$0.04	6
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	9455	10	$3,403.88	11%	100%	$0.04	1
Electric	Energy Efficiency	Nonmetallic Mineral Products	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	22823	10	$7,075.15	0%	100%	$0.03	0
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	12608	10	$3,908.45	0%	100%	$0.03	0
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	14540	10	$4,507.55	0%	100%	$0.03	0
Electric	Energy Efficiency	Nonmetallic Mineral Products	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	35891	10	$11,126.24	0%	100%	$0.03	0
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	5253	10	$1,628.40	0%	100%	$0.03	0
Electric	Energy Efficiency	Nonmetallic Mineral Products	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	547753	10	$11,464.48	27%	100%	$0.02	123
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	302590	10	$6,333.20	27%	100%	$0.02	56
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	348972	10	$7,303.98	27%	100%	$0.02	79
Electric	Energy Efficiency	Nonmetallic Mineral Products	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	861386	10	$18,028.82	27%	100%	$0.02	194
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	126070	10	$2,638.63	27%	100%	$0.02	28
Electric	Energy Efficiency	Nonmetallic Mineral Products	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	342346	10	$0.00	31%	100%	$0.01	86
Electric	Energy Efficiency	Nonmetallic Mineral Products	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	912922	10	$114,115.28	34%	100%	$0.03	240
Electric	Energy Efficiency	Nonmetallic Mineral Products	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	91292	10	$19,530.18	21%	100%	$0.02	15
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	50432	10	$10,788.85	21%	100%	$0.02	7
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	58162	10	$12,442.61	21%	100%	$0.02	9
Electric	Energy Efficiency	Nonmetallic Mineral Products	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	143564	10	$30,712.78	21%	100%	$0.02	24
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	21012	10	$4,495.02	21%	100%	$0.02	4
Electric	Energy Efficiency	Nonmetallic Mineral Products	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	68469	10	$6,804.32	9%	100%	$0.00	5
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	37824	10	$3,758.84	9%	100%	$0.00	3

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	43621	10	$4,335.01	9%	100%	$0.00	3
Electric	Energy Efficiency	Nonmetallic Mineral Products	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	107673	10	$10,700.34	9%	100%	$0.00	8
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	15759	10	$1,566.07	9%	100%	$0.00	1
Electric	Energy Efficiency	Nonmetallic Mineral Products	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	31289	10	$3,109.43	9%	100%	$0.00	2
Electric	Energy Efficiency	Nonmetallic Mineral Products	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	25614	10	$2,545.42	9%	100%	$0.00	2
Electric	Energy Efficiency	Nonmetallic Mineral Products	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	18715	32	$14,223.33	37%	100%	$0.06	5
Electric	Energy Efficiency	Nonmetallic Mineral Products	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	10338	32	$7,857.24	37%	100%	$0.06	2
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	11923	32	$9,061.64	37%	100%	$0.06	3
Electric	Energy Efficiency	Nonmetallic Mineral Products	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	29431	32	$22,367.33	37%	100%	$0.06	9
Electric	Energy Efficiency	Nonmetallic Mineral Products	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	4307	32	$3,273.60	37%	100%	$0.06	1
Electric	Energy Efficiency	Nonmetallic Mineral Products	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	8552	32	$6,499.77	37%	100%	$0.06	3
Electric	Energy Efficiency	Nonmetallic Mineral Products	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	7001	32	$5,320.79	37%	100%	$0.06	2
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	63930	10	$5,146.37	26%	100%	$0.02	14
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Air Compressor Equipment2	Air Compressor Equipment2		Existing	Per Industry	111878	10	$7,160.17	17%	100%	$0.02	10
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Air Compressor Optimization	Air Compressor Optimization		Existing	Per Industry	159825	10	$31,997.01	36%	100%	-$0.01	42
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Efficient Centrifugal Fan	Efficient Centrifugal Fan		Existing	Per Industry	544796	10	$99,053.75	11%	100%	$0.01	42
Electric	Energy Efficiency	Paper Mfg	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	278221	10	$7,026.63	20%	100%	-$0.01	46
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	632769	11	$77,886.63	27%	100%	$0.03	110
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	399007	11	$49,113.23	27%	100%	$0.03	59
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	92699	11	$11,410.14	27%	100%	$0.03	13
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	789954	11	$97,234.26	27%	100%	$0.03	145
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	30188	11	$3,715.79	27%	100%	$0.03	6
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	137589	10	$0.00	27%	100%	$0.01	24
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	481560	10	$41,276.61	23%	100%	$0.03	57
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	687943	10	$82,553.21	30%	100%	$0.00	151
Electric	Energy Efficiency	Paper Mfg	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	202704	10	$16,019.80	29%	100%	$0.00	43
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	1090981	11	$215,067.27	22%	100%	-$0.02	185
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	687943	11	$135,615.67	22%	100%	-$0.02	126
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	159825	11	$31,506.67	22%	100%	-$0.02	29

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	1361989	11	$268,491.62	22%	100%	-$0.02	250
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	52048	11	$10,260.35	22%	100%	-$0.02	10
Electric	Energy Efficiency	Paper Mfg	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	112105	10	$23,878.28	15%	100%	$0.02	11
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Material Handling VFD2	Material Handling VFD2		Existing	Per Industry	510128	10	$153,038.51	53%	100%	$0.03	171
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Material Handling2	Material Handling2		Existing	Per Industry	136459	10	$63,766.05	53%	100%	$0.06	39
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	10910	10	$1,200.08	23%	100%	$0.00	2
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	6879	10	$756.74	23%	100%	$0.00	1
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	1598	10	$175.81	23%	100%	$0.00	0
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	13620	10	$1,498.19	23%	100%	$0.00	3
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	520	10	$57.25	23%	100%	$0.00	0
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	10910	10	$1,636.47	13%	100%	$0.01	1
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	6879	10	$1,031.92	13%	100%	$0.01	1
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	1598	10	$239.74	13%	100%	$0.01	0
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	13620	10	$2,042.98	13%	100%	$0.01	1
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	520	10	$78.07	13%	100%	$0.01	0
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	10910	10	$2,509.26	9%	100%	$0.02	1
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	6879	10	$1,582.27	9%	100%	$0.02	0
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	1598	10	$367.60	9%	100%	$0.02	0
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	13620	10	$3,132.57	9%	100%	$0.02	1
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	520	10	$119.71	9%	100%	$0.02	0
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	19638	10	$7,069.56	6%	100%	$0.04	1
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	12383	10	$4,457.87	6%	100%	$0.04	0
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	2877	10	$1,035.67	6%	100%	$0.04	0
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	24516	10	$8,825.69	6%	100%	$0.04	1
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	937	10	$337.27	6%	100%	$0.04	0
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	10910	10	$3,382.04	10%	100%	$0.03	1
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	6879	10	$2,132.62	10%	100%	$0.03	0
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	1598	10	$495.46	10%	100%	$0.03	0
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	13620	10	$4,222.17	10%	100%	$0.03	1

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	520	10	$161.35	10%	100%	$0.03	0
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Paper: Efficient Pulp Screen	Paper: Efficient Pulp Screen		Existing	Per Industry	408597	10	$73,936.55	14%	100%	$0.01	49
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Paper: Large Material Handling	Paper: Large Material Handling		Existing	Per Industry	265267	10	$204,051.34	25%	100%	$0.11	34
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Paper: Material Handling	Paper: Material Handling		Existing	Per Industry	357090	10	$229,557.76	25%	100%	$0.09	47
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Paper: Premium Control Large Material	Paper: Premium Control Large Material		Existing	Per Industry	510128	10	$224,456.48	25%	100%	$0.05	72
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Paper: Premium Fan	Paper: Premium Fan		Existing	Per Industry	275177	10	$50,032.25	25%	100%	$0.01	57
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	261835	10	$5,480.22	27%	100%	$0.02	48
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	165106	10	$3,455.68	27%	100%	$0.02	25
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	38358	10	$802.83	27%	100%	$0.02	6
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	326877	10	$6,841.54	27%	100%	$0.02	62
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	12492	10	$261.45	27%	100%	$0.02	2
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	163647	10	$0.00	31%	100%	$0.01	34
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	436392	10	$54,549.05	34%	100%	$0.03	87
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Pump System Optimization	Pump System Optimization		Existing	Per Industry	1090981	12	$277,109.18	15%	100%	-$0.03	141
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	43639	10	$9,335.76	21%	100%	$0.02	6
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	27518	10	$5,886.88	21%	100%	$0.02	3
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	6393	10	$1,367.66	21%	100%	$0.02	1
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	54480	10	$11,654.83	21%	100%	$0.02	8
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	2082	10	$445.39	21%	100%	$0.02	0
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	32729	10	$3,252.58	9%	100%	$0.00	2
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	20638	10	$2,050.99	9%	100%	$0.00	1
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	4795	10	$476.49	9%	100%	$0.00	0
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	40860	10	$4,060.55	9%	100%	$0.00	3
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	1561	10	$155.17	9%	100%	$0.00	0
Electric	Energy Efficiency	Paper Mfg	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	4729	10	$469.97	9%	100%	$0.00	0
Electric	Energy Efficiency	Paper Mfg	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	6595	10	$655.40	9%	100%	$0.00	1
Electric	Energy Efficiency	Paper Mfg	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	5962	10	$592.48	9%	100%	$0.00	0
Electric	Energy Efficiency	Paper Mfg	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	3142	10	$312.20	9%	100%	$0.00	0
Electric	Energy Efficiency	Paper Mfg	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	8946	32	$6,798.99	37%	100%	$0.06	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Paper Mfg	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	5641	32	$4,287.26	37%	100%	$0.06	1
Electric	Energy Efficiency	Paper Mfg	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1311	32	$996.03	37%	100%	$0.06	0
Electric	Energy Efficiency	Paper Mfg	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	11168	32	$8,487.92	37%	100%	$0.06	2
Electric	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	427	32	$324.36	37%	100%	$0.06	0
Electric	Energy Efficiency	Paper Mfg	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1293	32	$982.40	37%	100%	$0.06	0
Electric	Energy Efficiency	Paper Mfg	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1803	32	$1,370.01	37%	100%	$0.06	1
Electric	Energy Efficiency	Paper Mfg	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1630	32	$1,238.48	37%	100%	$0.06	0
Electric	Energy Efficiency	Paper Mfg	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	859	32	$652.61	37%	100%	$0.06	0
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	118110	10	$9,507.83	26%	100%	$0.02	26
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Air Compressor Equipment2	Air Compressor Equipment2		Existing	Per Industry	206692	10	$13,228.28	17%	100%	$0.02	19
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Air Compressor Optimization	Air Compressor Optimization		Existing	Per Industry	295274	10	$59,113.90	36%	100%	-$0.01	78
Electric	Energy Efficiency	Petroleum Coal Products	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	72930	10	$1,841.89	20%	100%	-$0.01	12
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	268812	11	$33,087.64	27%	100%	$0.03	47
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	148497	11	$18,278.26	27%	100%	$0.03	24
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	171259	11	$21,080.03	27%	100%	$0.03	24
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	422728	11	$52,032.99	27%	100%	$0.03	81
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	51206	10	$0.00	27%	100%	$0.01	9
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	179220	10	$15,361.73	23%	100%	$0.03	23
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	256029	10	$30,723.47	30%	100%	$0.00	56
Electric	Energy Efficiency	Petroleum Coal Products	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	53135	10	$4,199.27	29%	100%	$0.00	11
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	463468	11	$91,364.45	22%	100%	-$0.02	79
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	256029	11	$50,471.49	22%	100%	-$0.02	47
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	295274	11	$58,208.00	22%	100%	-$0.02	54
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	728841	11	$143,677.97	22%	100%	-$0.02	134
Electric	Energy Efficiency	Petroleum Coal Products	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	29386	10	$6,259.21	15%	100%	$0.02	3
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	4635	10	$509.82	8%	100%	$0.00	0
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	2560	10	$281.63	8%	100%	$0.00	0
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	2953	10	$324.80	8%	100%	$0.00	0
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	7288	10	$801.73	8%	100%	$0.00	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	4635	10	$695.20	12%	100%	$0.01	0
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	2560	10	$384.04	12%	100%	$0.01	0
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	2953	10	$442.91	12%	100%	$0.01	0
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	7288	10	$1,093.26	12%	100%	$0.01	1
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	4635	10	$1,065.98	12%	100%	$0.02	0
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	2560	10	$588.87	12%	100%	$0.02	0
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	2953	10	$679.13	12%	100%	$0.02	0
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	7288	10	$1,676.34	12%	100%	$0.02	1
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	8342	10	$3,003.28	8%	100%	$0.04	0
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	4609	10	$1,659.07	8%	100%	$0.04	0
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	5315	10	$1,913.38	8%	100%	$0.04	0
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	13119	10	$4,722.89	8%	100%	$0.04	1
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	4635	10	$1,436.75	10%	100%	$0.03	0
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	2560	10	$793.69	10%	100%	$0.03	0
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	2953	10	$915.35	10%	100%	$0.03	0
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	7288	10	$2,259.41	10%	100%	$0.03	0
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	111232	10	$2,328.09	27%	100%	$0.02	21
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	61447	10	$1,286.08	27%	100%	$0.02	10
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	70866	10	$1,483.22	27%	100%	$0.02	12
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	174922	10	$3,661.12	27%	100%	$0.02	35
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	69520	10	$0.00	31%	100%	$0.01	14
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	185387	10	$23,173.42	34%	100%	$0.03	37
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Pump System Optimization	Pump System Optimization		Existing	Per Industry	463468	12	$117,720.97	15%	100%	-$0.03	60
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	18539	10	$3,966.00	21%	100%	$0.02	3
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	10241	10	$2,190.89	21%	100%	$0.02	1
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	11811	10	$2,526.72	21%	100%	$0.02	1
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	29154	10	$6,236.85	21%	100%	$0.02	4
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	13904	10	$1,381.76	9%	100%	$0.00	1
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	7681	10	$763.31	9%	100%	$0.00	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	8858	10	$880.31	9%	100%	$0.00	1
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	21865	10	$2,172.92	9%	100%	$0.00	2
Electric	Energy Efficiency	Petroleum Coal Products	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	2141	10	$212.82	9%	100%	$0.00	0
Electric	Energy Efficiency	Petroleum Coal Products	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	1563	10	$155.31	9%	100%	$0.00	0
Electric	Energy Efficiency	Petroleum Coal Products	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	542	10	$53.88	9%	100%	$0.00	0
Electric	Energy Efficiency	Petroleum Coal Products	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	3800	32	$2,888.34	37%	100%	$0.06	1
Electric	Energy Efficiency	Petroleum Coal Products	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	2099	32	$1,595.57	37%	100%	$0.06	0
Electric	Energy Efficiency	Petroleum Coal Products	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	2421	32	$1,840.15	37%	100%	$0.06	0
Electric	Energy Efficiency	Petroleum Coal Products	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	5976	32	$4,542.14	37%	100%	$0.06	1
Electric	Energy Efficiency	Petroleum Coal Products	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	585	32	$444.86	37%	100%	$0.06	0
Electric	Energy Efficiency	Petroleum Coal Products	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	427	32	$324.64	37%	100%	$0.06	0
Electric	Energy Efficiency	Petroleum Coal Products	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	148	32	$112.62	37%	100%	$0.06	0
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	387032	10	$31,156.09	26%	100%	$0.02	84
Electric	Energy Efficiency	Plastics Rubber Products	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	1460869	10	$36,895.10	13%	100%	-$0.01	154
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	167796	10	$0.00	27%	100%	$0.01	32
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	587285	10	$50,338.69	23%	100%	$0.03	90
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	838978	10	$100,677.37	30%	100%	$0.00	207
Electric	Energy Efficiency	Plastics Rubber Products	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	1064347	10	$84,115.97	19%	100%	$0.00	154
Electric	Energy Efficiency	Plastics Rubber Products	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	588633	10	$125,378.89	15%	100%	$0.02	62
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	15187	10	$1,670.61	17%	100%	$0.00	2
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	8390	10	$922.88	17%	100%	$0.00	1
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Motors: Rewind 501-5000 HP	Motors: Rewind 501-5000 HP		Existing	Per Industry	9676	10	$1,064.34	17%	100%	$0.00	1
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	15187	10	$2,278.10	20%	100%	$0.01	3
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	8390	10	$1,258.47	20%	100%	$0.01	1
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	9676	10	$1,451.37	20%	100%	$0.01	2
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	15187	10	$3,493.09	4%	100%	$0.02	0
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	8390	10	$1,929.65	4%	100%	$0.02	0
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	9676	10	$2,225.44	4%	100%	$0.02	0
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	27337	10	$9,841.40	11%	100%	$0.04	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	15102	10	$5,436.58	11%	100%	$0.04	1
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	17416	10	$6,269.92	11%	100%	$0.04	2
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	15187	10	$4,708.08	7%	100%	$0.03	1
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	8390	10	$2,600.83	7%	100%	$0.03	0
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	9676	10	$2,999.50	7%	100%	$0.03	1
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	364496	10	$7,628.90	27%	100%	$0.02	82
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	201355	10	$4,214.35	27%	100%	$0.02	37
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	232219	10	$4,860.35	27%	100%	$0.02	52
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	227810	10	$0.00	31%	100%	$0.01	57
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	607494	10	$75,936.70	34%	100%	$0.03	160
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	60749	10	$12,996.13	21%	100%	$0.02	10
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	33559	10	$7,179.32	21%	100%	$0.02	5
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	38703	10	$8,279.79	21%	100%	$0.02	6
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	45562	10	$4,527.86	9%	100%	$0.00	4
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	25169	10	$2,501.28	9%	100%	$0.00	2
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	29027	10	$2,884.68	9%	100%	$0.00	2
Electric	Energy Efficiency	Plastics Rubber Products	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	55953	10	$5,560.53	9%	100%	$0.00	4
Electric	Energy Efficiency	Plastics Rubber Products	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	39219	10	$3,897.54	9%	100%	$0.00	3
Electric	Energy Efficiency	Plastics Rubber Products	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	31304	10	$3,110.96	9%	100%	$0.00	2
Electric	Energy Efficiency	Plastics Rubber Products	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	13742	10	$1,365.64	9%	100%	$0.00	1
Electric	Energy Efficiency	Plastics Rubber Products	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	12454	32	$9,464.75	37%	100%	$0.06	3
Electric	Energy Efficiency	Plastics Rubber Products	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	6880	32	$5,228.51	37%	100%	$0.06	2
Electric	Energy Efficiency	Plastics Rubber Products	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	7934	32	$6,029.96	37%	100%	$0.06	2
Electric	Energy Efficiency	Plastics Rubber Products	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	15294	32	$11,623.39	37%	100%	$0.06	5
Electric	Energy Efficiency	Plastics Rubber Products	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	10720	32	$8,147.18	37%	100%	$0.06	3
Electric	Energy Efficiency	Plastics Rubber Products	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	8557	32	$6,502.95	37%	100%	$0.06	2
Electric	Energy Efficiency	Plastics Rubber Products	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	3756	32	$2,854.64	37%	100%	$0.06	1
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	73246	10	$5,896.29	26%	100%	$0.02	16
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Air Compressor Equipment2	Air Compressor Equipment2		Existing	Per Industry	128180	10	$8,203.54	17%	100%	$0.02	14

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Air Compressor Optimization	Air Compressor Optimization		Existing	Per Industry	183115	10	$36,659.57	36%	100%	-$0.01	54
Electric	Energy Efficiency	Primary Metal Mfg	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	204335	10	$5,160.61	13%	100%	-$0.01	22
Electric	Energy Efficiency	Primary Metal Mfg	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	39184	10	$0.00	27%	100%	$0.01	9
Electric	Energy Efficiency	Primary Metal Mfg	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	148873	10	$11,765.50	19%	100%	$0.00	21
Electric	Energy Efficiency	Primary Metal Mfg	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	82334	10	$17,537.05	15%	100%	$0.02	9
Electric	Energy Efficiency	Primary Metal Mfg	Process Electro Chemical	Retrofit	Metal: New Arc Furnace	Metal: New Arc Furnace		Existing	Per Industry	1253016	10	$115,687.89	10%	100%	-$1.86	105
Electric	Energy Efficiency	Primary Metal Mfg	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	1114	10	$256.23	17%	100%	$0.02	0
Electric	Energy Efficiency	Primary Metal Mfg	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	1959	10	$450.62	17%	100%	$0.02	0
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	1831	10	$421.16	17%	100%	$0.02	0
Electric	Energy Efficiency	Primary Metal Mfg	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	7888	10	$1,814.24	17%	100%	$0.02	1
Electric	Energy Efficiency	Primary Metal Mfg	Process Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	356	10	$81.82	17%	100%	$0.02	0
Electric	Energy Efficiency	Primary Metal Mfg	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	2005	10	$721.91	11%	100%	$0.04	0
Electric	Energy Efficiency	Primary Metal Mfg	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	3527	10	$1,269.56	11%	100%	$0.04	0
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	3296	10	$1,186.58	11%	100%	$0.04	0
Electric	Energy Efficiency	Primary Metal Mfg	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	14198	10	$5,111.44	11%	100%	$0.04	1
Electric	Energy Efficiency	Primary Metal Mfg	Process Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	640	10	$230.52	11%	100%	$0.04	0
Electric	Energy Efficiency	Primary Metal Mfg	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	1114	10	$345.36	0%	100%	$0.03	0
Electric	Energy Efficiency	Primary Metal Mfg	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	1959	10	$607.35	0%	100%	$0.03	0
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	1831	10	$567.66	0%	100%	$0.03	0
Electric	Energy Efficiency	Primary Metal Mfg	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	7888	10	$2,445.29	0%	100%	$0.03	0
Electric	Energy Efficiency	Primary Metal Mfg	Process Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	356	10	$110.28	0%	100%	$0.03	0
Electric	Energy Efficiency	Primary Metal Mfg	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	26737	10	$559.61	27%	100%	$0.02	6
Electric	Energy Efficiency	Primary Metal Mfg	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	47021	10	$984.15	27%	100%	$0.02	10
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	43948	10	$919.82	27%	100%	$0.02	8
Electric	Energy Efficiency	Primary Metal Mfg	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	189312	10	$3,962.31	27%	100%	$0.02	43
Electric	Energy Efficiency	Primary Metal Mfg	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	8538	10	$178.70	27%	100%	$0.02	2
Electric	Energy Efficiency	Primary Metal Mfg	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	16711	10	$0.00	31%	100%	$0.01	4
Electric	Energy Efficiency	Primary Metal Mfg	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	4456	10	$953.32	21%	100%	$0.02	1
Electric	Energy Efficiency	Primary Metal Mfg	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	7837	10	$1,676.53	21%	100%	$0.02	1

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	7325	10	$1,566.95	21%	100%	$0.02	1
Electric	Energy Efficiency	Primary Metal Mfg	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	31552	10	$6,749.95	21%	100%	$0.02	5
Electric	Energy Efficiency	Primary Metal Mfg	Process Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	1423	10	$304.42	21%	100%	$0.02	0
Electric	Energy Efficiency	Primary Metal Mfg	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	3342	10	$332.14	9%	100%	$0.00	0
Electric	Energy Efficiency	Primary Metal Mfg	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	5878	10	$584.10	9%	100%	$0.00	0
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	5493	10	$545.93	9%	100%	$0.00	0
Electric	Energy Efficiency	Primary Metal Mfg	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	23664	10	$2,351.68	9%	100%	$0.00	2
Electric	Energy Efficiency	Primary Metal Mfg	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	1067	10	$106.06	9%	100%	$0.00	0
Electric	Energy Efficiency	Primary Metal Mfg	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	38227	10	$3,798.89	9%	100%	$0.00	3
Electric	Energy Efficiency	Primary Metal Mfg	Process Electro Chemical	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	41767	10	$4,150.74	9%	100%	$0.00	3
Electric	Energy Efficiency	Primary Metal Mfg	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	4476	10	$444.77	9%	100%	$0.00	0
Electric	Energy Efficiency	Primary Metal Mfg	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	4379	10	$435.14	9%	100%	$0.00	0
Electric	Energy Efficiency	Primary Metal Mfg	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	1596	10	$158.60	9%	100%	$0.00	0
Electric	Energy Efficiency	Primary Metal Mfg	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	914	32	$694.28	37%	100%	$0.06	0
Electric	Energy Efficiency	Primary Metal Mfg	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1607	32	$1,220.97	37%	100%	$0.06	0
Electric	Energy Efficiency	Primary Metal Mfg	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1502	32	$1,141.17	37%	100%	$0.06	0
Electric	Energy Efficiency	Primary Metal Mfg	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	6468	32	$4,915.81	37%	100%	$0.06	2
Electric	Energy Efficiency	Primary Metal Mfg	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	292	32	$221.70	37%	100%	$0.06	0
Electric	Energy Efficiency	Primary Metal Mfg	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	10449	32	$7,940.96	37%	100%	$0.06	3
Electric	Energy Efficiency	Primary Metal Mfg	Process Electro Chemical	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	11416	32	$8,676.44	37%	100%	$0.06	3
Electric	Energy Efficiency	Primary Metal Mfg	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1223	32	$929.72	37%	100%	$0.06	0
Electric	Energy Efficiency	Primary Metal Mfg	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1197	32	$909.58	37%	100%	$0.06	0
Electric	Energy Efficiency	Primary Metal Mfg	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	436	32	$331.53	37%	100%	$0.06	0
Electric	Energy Efficiency	Printing Related Support	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	832822	10	$67,042.14	26%	100%	$0.02	180
Electric	Energy Efficiency	Printing Related Support	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	4295719	10	$108,490.91	13%	100%	-$0.01	453
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	361065	10	$0.00	27%	100%	$0.01	70
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	1263728	10	$108,319.52	23%	100%	$0.03	195
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	1805325	10	$216,639.04	30%	100%	$0.00	446
Electric	Energy Efficiency	Printing Related Support	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	3129738	10	$247,344.97	19%	100%	$0.00	451

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Printing Related Support	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	1730890	10	$368,679.55	15%	100%	$0.02	183
Electric	Energy Efficiency	Printing Related Support	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	32680	10	$7,516.48	17%	100%	$0.02	4
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	18053	10	$4,152.25	17%	100%	$0.02	2
Electric	Energy Efficiency	Printing Related Support	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	20821	10	$4,788.72	17%	100%	$0.02	3
Electric	Energy Efficiency	Printing Related Support	Process Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	959	10	$220.54	17%	100%	$0.02	0
Electric	Energy Efficiency	Printing Related Support	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	58825	10	$21,176.86	11%	100%	$0.04	5
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	32496	10	$11,698.51	11%	100%	$0.04	2
Electric	Energy Efficiency	Printing Related Support	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	37477	10	$13,491.71	11%	100%	$0.04	3
Electric	Energy Efficiency	Printing Related Support	Process Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	1726	10	$621.35	11%	100%	$0.04	0
Electric	Energy Efficiency	Printing Related Support	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	32680	10	$10,130.91	0%	100%	$0.03	0
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	18053	10	$5,596.51	0%	100%	$0.03	0
Electric	Energy Efficiency	Printing Related Support	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	20821	10	$6,454.37	0%	100%	$0.03	0
Electric	Energy Efficiency	Printing Related Support	Process Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	959	10	$297.25	0%	100%	$0.03	0
Electric	Energy Efficiency	Printing Related Support	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	784328	10	$16,415.99	27%	100%	$0.02	177
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	433278	10	$9,068.51	27%	100%	$0.02	81
Electric	Energy Efficiency	Printing Related Support	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	499693	10	$10,458.57	27%	100%	$0.02	112
Electric	Energy Efficiency	Printing Related Support	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	23013	10	$481.66	27%	100%	$0.02	5
Electric	Energy Efficiency	Printing Related Support	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	490205	10	$0.00	31%	100%	$0.01	123
Electric	Energy Efficiency	Printing Related Support	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	1307214	10	$163,401.71	34%	100%	$0.03	344
Electric	Energy Efficiency	Printing Related Support	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	130721	10	$27,965.27	21%	100%	$0.02	22
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	72213	10	$15,448.56	21%	100%	$0.02	10
Electric	Energy Efficiency	Printing Related Support	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	83282	10	$17,816.58	21%	100%	$0.02	13
Electric	Energy Efficiency	Printing Related Support	Process Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	3835	10	$820.52	21%	100%	$0.02	1
Electric	Energy Efficiency	Printing Related Support	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	98041	10	$9,743.11	9%	100%	$0.00	8
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	54160	10	$5,382.28	9%	100%	$0.00	4
Electric	Energy Efficiency	Printing Related Support	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	62462	10	$6,207.30	9%	100%	$0.00	5
Electric	Energy Efficiency	Printing Related Support	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	2877	10	$285.87	9%	100%	$0.00	0
Electric	Energy Efficiency	Printing Related Support	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	21956	10	$2,181.95	9%	100%	$0.00	2
Electric	Energy Efficiency	Printing Related Support	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	142714	10	$14,182.66	9%	100%	$0.00	11

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Printing Related Support	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	92051	10	$9,147.85	9%	100%	$0.00	6
Electric	Energy Efficiency	Printing Related Support	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	48080	10	$4,778.12	9%	100%	$0.00	4
Electric	Energy Efficiency	Printing Related Support	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	26798	32	$20,366.39	37%	100%	$0.06	7
Electric	Energy Efficiency	Printing Related Support	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	14804	32	$11,250.79	37%	100%	$0.06	3
Electric	Energy Efficiency	Printing Related Support	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	17073	32	$12,975.36	37%	100%	$0.06	5
Electric	Energy Efficiency	Printing Related Support	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	786	32	$597.57	37%	100%	$0.06	0
Electric	Energy Efficiency	Printing Related Support	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	6001	32	$4,561.01	37%	100%	$0.06	2
Electric	Energy Efficiency	Printing Related Support	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	39009	32	$29,646.55	37%	100%	$0.06	12
Electric	Energy Efficiency	Printing Related Support	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	25161	32	$19,122.09	37%	100%	$0.06	6
Electric	Energy Efficiency	Printing Related Support	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	13142	32	$9,987.88	37%	100%	$0.06	4
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	1197994	10	$96,438.50	26%	100%	$0.02	259
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Air Compressor Equipment2	Air Compressor Equipment2		Existing	Per Industry	2096489	10	$134,175.31	17%	100%	$0.02	222
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Air Compressor Optimization	Air Compressor Optimization		Existing	Per Industry	2994985	10	$599,595.90	36%	100%	-$0.01	890
Electric	Energy Efficiency	Transportation Equipment Mfg	Lighting	Retrofit	Efficient Lighting 1 Shift	Efficient Lighting 1 Shift		Existing	Per Industry	5966257	10	$461,527.37	5%	100%	$0.00	234
Electric	Energy Efficiency	Transportation Equipment Mfg	Lighting	Retrofit	Efficient Lighting 2 Shift	Efficient Lighting 2 Shift		Existing	Per Industry	5966257	10	$270,042.61	2%	100%	-$0.01	87
Electric	Energy Efficiency	Transportation Equipment Mfg	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	5966257	10	$150,681.31	13%	100%	-$0.01	629
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	257331	10	$0.00	27%	100%	$0.01	50
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	900658	10	$77,199.24	23%	100%	$0.03	139
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	1286654	10	$154,398.48	30%	100%	$0.00	318
Electric	Energy Efficiency	Transportation Equipment Mfg	Lighting	Retrofit	HighBay Lighting 1 Shift	HighBay Lighting 1 Shift		Existing	Per Industry	4346844	10	###########	8%	100%	$0.02	219
Electric	Energy Efficiency	Transportation Equipment Mfg	Lighting	Retrofit	HighBay Lighting 2 Shift	HighBay Lighting 2 Shift		Existing	Per Industry	4346844	10	$615,661.54	3%	100%	$0.01	74
Electric	Energy Efficiency	Transportation Equipment Mfg	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	4346844	10	$343,533.52	19%	100%	$0.00	596
Electric	Energy Efficiency	Transportation Equipment Mfg	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	2404006	10	$512,053.21	15%	100%	$0.02	228
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	12867	10	$2,959.30	17%	100%	$0.02	2
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	29950	10	$6,888.46	17%	100%	$0.02	3
Electric	Energy Efficiency	Transportation Equipment Mfg	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	28869	10	$6,639.78	17%	100%	$0.02	4
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	7358	10	$1,692.39	17%	100%	$0.02	1
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	23160	10	$8,337.52	11%	100%	$0.04	2
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	53910	10	$19,407.50	11%	100%	$0.04	4

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Transportation Equipment Mfg	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	51964	10	$18,706.87	11%	100%	$0.04	5
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	13245	10	$4,768.12	11%	100%	$0.04	1
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	12867	10	$3,988.63	0%	100%	$0.03	0
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	29950	10	$9,284.45	0%	100%	$0.03	0
Electric	Energy Efficiency	Transportation Equipment Mfg	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	28869	10	$8,949.27	0%	100%	$0.03	0
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	7358	10	$2,281.05	0%	100%	$0.03	0
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	308797	10	$6,463.12	27%	100%	$0.02	58
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	718796	10	$15,044.41	27%	100%	$0.02	133
Electric	Energy Efficiency	Transportation Equipment Mfg	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	692847	10	$14,501.29	27%	100%	$0.02	156
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	176597	10	$3,696.18	27%	100%	$0.02	40
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	51466	10	$11,010.17	21%	100%	$0.02	7
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	119799	10	$25,628.72	21%	100%	$0.02	15
Electric	Energy Efficiency	Transportation Equipment Mfg	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	115474	10	$24,703.50	21%	100%	$0.02	20
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	29433	10	$6,296.58	21%	100%	$0.02	5
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	38600	10	$3,835.95	9%	100%	$0.00	3
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	89850	10	$8,929.06	9%	100%	$0.00	6
Electric	Energy Efficiency	Transportation Equipment Mfg	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	86606	10	$8,606.71	9%	100%	$0.00	7
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	22075	10	$2,193.73	9%	100%	$0.00	2
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	118449	10	$11,771.24	9%	100%	$0.00	9
Electric	Energy Efficiency	Transportation Equipment Mfg	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	167813	10	$16,676.95	9%	100%	$0.00	13
Electric	Energy Efficiency	Transportation Equipment Mfg	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	127848	10	$12,705.30	9%	100%	$0.00	8
Electric	Energy Efficiency	Transportation Equipment Mfg	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	47211	10	$4,691.68	9%	100%	$0.00	4
Electric	Energy Efficiency	Transportation Equipment Mfg	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	10551	32	$8,018.43	37%	100%	$0.06	2
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	24559	32	$18,664.74	37%	100%	$0.06	5
Electric	Energy Efficiency	Transportation Equipment Mfg	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	23672	32	$17,990.93	37%	100%	$0.06	7
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	6034	32	$4,585.64	37%	100%	$0.06	2
Electric	Energy Efficiency	Transportation Equipment Mfg	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	32376	32	$24,605.87	37%	100%	$0.06	10
Electric	Energy Efficiency	Transportation Equipment Mfg	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	45869	32	$34,860.45	37%	100%	$0.06	14
Electric	Energy Efficiency	Transportation Equipment Mfg	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	34945	32	$26,558.37	37%	100%	$0.06	8

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Transportation Equipment Mfg	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	12904	32	$9,807.20	37%	100%	$0.06	4
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	1054210	10	$84,863.92	26%	100%	$0.02	228
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Air Compressor Equipment2	Air Compressor Equipment2		Existing	Per Industry	1844868	10	$118,071.54	17%	100%	$0.02	195
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Air Compressor Optimization	Air Compressor Optimization		Existing	Per Industry	2635526	10	$527,632.21	36%	100%	-$0.01	783
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Efficient Centrifugal Fan	Efficient Centrifugal Fan		Existing	Per Industry	2602164	10	$473,120.81	11%	100%	$0.01	195
Electric	Energy Efficiency	Wood Product Mfg	Lighting	Retrofit	Efficient Lighting 1 Shift	Efficient Lighting 1 Shift		Existing	Per Industry	2130202	10	$164,784.51	4%	100%	$0.00	71
Electric	Energy Efficiency	Wood Product Mfg	Lighting	Retrofit	Efficient Lighting 2 Shift	Efficient Lighting 2 Shift		Existing	Per Industry	2130202	10	$96,416.47	5%	100%	-$0.01	88
Electric	Energy Efficiency	Wood Product Mfg	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	2130202	10	$53,799.51	10%	100%	-$0.01	182
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	457047	10	$0.00	27%	100%	$0.01	88
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	1599664	10	$137,114.05	23%	100%	$0.03	247
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	2285234	10	$274,228.10	30%	100%	$0.00	565
Electric	Energy Efficiency	Wood Product Mfg	Lighting	Retrofit	HighBay Lighting 1 Shift	HighBay Lighting 1 Shift		Existing	Per Industry	1552005	10	$375,686.95	7%	100%	$0.02	66
Electric	Energy Efficiency	Wood Product Mfg	Lighting	Retrofit	HighBay Lighting 2 Shift	HighBay Lighting 2 Shift		Existing	Per Industry	1552005	10	$219,816.83	7%	100%	$0.01	76
Electric	Energy Efficiency	Wood Product Mfg	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	1552005	10	$122,655.78	15%	100%	$0.00	172
Electric	Energy Efficiency	Wood Product Mfg	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	858330	10	$182,824.34	15%	100%	$0.02	82
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Material Handling VFD2	Material Handling VFD2		Existing	Per Industry	2436580	10	$730,973.89	53%	100%	$0.03	874
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Material Handling2	Material Handling2		Existing	Per Industry	651785	10	$304,572.45	53%	100%	$0.06	210
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	22852	10	$3,427.85	8%	100%	$0.01	2
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	26355	10	$3,953.29	8%	100%	$0.01	2
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	65054	10	$9,758.12	8%	100%	$0.01	5
Electric	Energy Efficiency	Wood Product Mfg	Process Other	Retrofit	Motors: Rewind 201-500 HP	Motors: Rewind 201-500 HP		Existing	Per Industry	923	10	$138.52	8%	100%	$0.01	0
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	22852	10	$5,256.04	29%	100%	$0.02	4
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	26355	10	$6,061.71	29%	100%	$0.02	4
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	65054	10	$14,962.45	29%	100%	$0.02	13
Electric	Energy Efficiency	Wood Product Mfg	Process Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	923	10	$212.39	29%	100%	$0.02	0
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	41134	10	$14,808.32	9%	100%	$0.04	2
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	47439	10	$17,078.21	9%	100%	$0.04	3
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	117097	10	$42,155.06	9%	100%	$0.04	7
Electric	Energy Efficiency	Wood Product Mfg	Process Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	1662	10	$598.40	9%	100%	$0.04	0

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	22852	10	$7,084.23	12%	100%	$0.03	2
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	26355	10	$8,170.13	12%	100%	$0.03	2
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	65054	10	$20,166.77	12%	100%	$0.03	5
Electric	Energy Efficiency	Wood Product Mfg	Process Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	923	10	$286.27	12%	100%	$0.03	0
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	548456	10	$11,479.19	27%	100%	$0.02	102
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	632526	10	$13,238.77	27%	100%	$0.02	117
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	1561299	10	$32,677.98	27%	100%	$0.02	294
Electric	Energy Efficiency	Wood Product Mfg	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	22163	10	$463.87	27%	100%	$0.02	5
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	91409	10	$19,555.24	21%	100%	$0.02	13
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	105421	10	$22,552.76	21%	100%	$0.02	13
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	260216	10	$55,668.19	21%	100%	$0.02	37
Electric	Energy Efficiency	Wood Product Mfg	Process Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	3694	10	$790.22	21%	100%	$0.02	1
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Wood: Replace Pneumatic Conveyor	Wood: Replace Pneumatic Conveyor		Existing	Per Industry	3773138	10	$54,710.51	50%	100%	-$0.07	1,575
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	68557	10	$6,813.05	9%	100%	$0.00	5
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	79066	10	$7,857.39	9%	100%	$0.00	5
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	195162	10	$19,394.82	9%	100%	$0.00	13
Electric	Energy Efficiency	Wood Product Mfg	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	2770	10	$275.31	9%	100%	$0.00	0
Electric	Energy Efficiency	Wood Product Mfg	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	49002	10	$4,869.73	9%	100%	$0.00	4
Electric	Energy Efficiency	Wood Product Mfg	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	32685	10	$3,248.17	9%	100%	$0.00	3
Electric	Energy Efficiency	Wood Product Mfg	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	45647	10	$4,536.32	9%	100%	$0.00	3
Electric	Energy Efficiency	Wood Product Mfg	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	26788	10	$2,662.18	9%	100%	$0.00	2
Electric	Energy Efficiency	Wood Product Mfg	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	18739	32	$14,241.58	37%	100%	$0.06	4
Electric	Energy Efficiency	Wood Product Mfg	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	21611	32	$16,424.60	37%	100%	$0.06	5
Electric	Energy Efficiency	Wood Product Mfg	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	53344	32	$40,541.72	37%	100%	$0.06	12
Electric	Energy Efficiency	Wood Product Mfg	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	757	32	$575.49	37%	100%	$0.06	0
Electric	Energy Efficiency	Wood Product Mfg	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	13394	32	$10,179.37	37%	100%	$0.06	4
Electric	Energy Efficiency	Wood Product Mfg	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	8934	32	$6,789.77	37%	100%	$0.06	3
Electric	Energy Efficiency	Wood Product Mfg	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	12477	32	$9,482.44	37%	100%	$0.06	3
Electric	Energy Efficiency	Wood Product Mfg	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	7322	32	$5,564.86	37%	100%	$0.06	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	11244969	10	$905,220.02	26%	100%	$0.02	2,436
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Air Compressor Equipment2	Air Compressor Equipment2		Existing	Per Industry	19678696	10	###########	17%	100%	$0.02	1,840
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Air Compressor Optimization	Air Compressor Optimization		Existing	Per Industry	28112423	10	###########	36%	100%	-$0.01	7,434
Electric	Energy Efficiency	Wastewater	Lighting	Retrofit	Efficient Lighting 1 Shift	Efficient Lighting 1 Shift		Existing	Per Industry	1189045	10	$91,980.09	5%	100%	$0.00	47
Electric	Energy Efficiency	Wastewater	Lighting	Retrofit	Efficient Lighting 2 Shift	Efficient Lighting 2 Shift		Existing	Per Industry	1189045	10	$53,818.14	2%	100%	-$0.01	17
Electric	Energy Efficiency	Wastewater	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	1189045	10	$30,030.03	13%	100%	-$0.01	125
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	4334919	11	$533,578.94	27%	100%	$0.03	754
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	16305205	11	###########	27%	100%	$0.03	2,252
Electric	Energy Efficiency	Wastewater	Lighting	Retrofit	HighBay Lighting 1 Shift	HighBay Lighting 1 Shift		Existing	Per Industry	866304	10	$209,702.49	8%	100%	$0.02	44
Electric	Energy Efficiency	Wastewater	Lighting	Retrofit	HighBay Lighting 2 Shift	HighBay Lighting 2 Shift		Existing	Per Industry	866304	10	$122,698.26	3%	100%	$0.01	15
Electric	Energy Efficiency	Wastewater	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	866304	10	$68,464.51	19%	100%	$0.00	119
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	7473998	11	###########	22%	100%	-$0.02	1,267
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	28112423	11	###########	22%	100%	-$0.02	5,164
Electric	Energy Efficiency	Wastewater	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	479106	10	$102,049.64	15%	100%	$0.02	45
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	74740	10	$17,190.19	17%	100%	$0.02	8
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	281124	10	$64,658.57	17%	100%	$0.02	25
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	134532	10	$48,431.50	11%	100%	$0.04	8
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	506024	10	$182,168.50	11%	100%	$0.04	27
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	74740	10	$23,169.39	0%	100%	$0.03	0
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	281124	10	$87,148.51	0%	100%	$0.03	0
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	1793759	10	$37,543.39	27%	100%	$0.02	332
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	6746982	10	$141,214.32	27%	100%	$0.02	1,111
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	1121100	10	$0.00	31%	100%	$0.01	230
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	2989599	10	$373,699.88	34%	100%	$0.03	595
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Pump System Optimization	Pump System Optimization		Existing	Per Industry	7473998	12	###########	15%	100%	-$0.03	963
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	298960	10	$63,956.60	21%	100%	$0.02	41
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	1124497	10	$240,564.02	21%	100%	$0.02	121
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	224220	10	$22,282.50	9%	100%	$0.00	14
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	843373	10	$83,812.59	9%	100%	$0.00	48

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Wastewater	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	25480	10	$2,532.10	9%	100%	$0.00	2
Electric	Energy Efficiency	Wastewater	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	178357	10	$17,724.72	9%	100%	$0.00	14
Electric	Energy Efficiency	Wastewater	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	61287	32	$46,577.95	37%	100%	$0.06	13
Electric	Energy Efficiency	Wastewater	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	230522	32	$175,196.62	37%	100%	$0.06	40
Electric	Energy Efficiency	Wastewater	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	6964	32	$5,292.95	37%	100%	$0.06	2
Electric	Energy Efficiency	Wastewater	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	48751	32	$37,050.64	37%	100%	$0.06	15
Electric	Energy Efficiency	Water	Lighting	Retrofit	Efficient Lighting 1 Shift	Efficient Lighting 1 Shift		Existing	Per Industry	7024343	10	$543,377.02	5%	100%	$0.00	276
Electric	Energy Efficiency	Water	Lighting	Retrofit	Efficient Lighting 2 Shift	Efficient Lighting 2 Shift		Existing	Per Industry	7024343	10	$317,933.36	2%	100%	-$0.01	102
Electric	Energy Efficiency	Water	Lighting	Retrofit	Efficient Lighting 3 Shift	Efficient Lighting 3 Shift		Existing	Per Industry	7024343	10	$177,403.91	13%	100%	-$0.01	741
Electric	Energy Efficiency	Water	Pumps	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	93122723	11	###########	27%	100%	$0.03	16,189
Electric	Energy Efficiency	Water	Fans	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	14404921	11	###########	27%	100%	$0.03	2,303
Electric	Energy Efficiency	Water	Motors Other	Retrofit	Energy Project Management	Energy Project Management		Existing	Per Industry	14404921	11	###########	27%	100%	$0.03	2,778
Electric	Energy Efficiency	Water	Fans	Retrofit	Fan Energy Management	Fan Energy Management		Existing	Per Industry	4967214	10	$0.00	27%	100%	$0.01	854
Electric	Energy Efficiency	Water	Fans	Retrofit	Fan Equipment Upgrade	Fan Equipment Upgrade		Existing	Per Industry	17385250	10	###########	23%	100%	$0.03	2,201
Electric	Energy Efficiency	Water	Fans	Retrofit	Fan System Optimization	Fan System Optimization		Existing	Per Industry	24836071	10	###########	30%	100%	$0.00	5,462
Electric	Energy Efficiency	Water	Lighting	Retrofit	HighBay Lighting 1 Shift	HighBay Lighting 1 Shift		Existing	Per Industry	5117736	10	###########	8%	100%	$0.02	258
Electric	Energy Efficiency	Water	Lighting	Retrofit	HighBay Lighting 2 Shift	HighBay Lighting 2 Shift		Existing	Per Industry	5117736	10	$724,846.14	3%	100%	$0.01	87
Electric	Energy Efficiency	Water	Lighting	Retrofit	HighBay Lighting 3 Shift	HighBay Lighting 3 Shift		Existing	Per Industry	5117736	10	$404,457.52	19%	100%	$0.00	702
Electric	Energy Efficiency	Water	Pumps	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	160556420	11	###########	22%	100%	-$0.02	27,215
Electric	Energy Efficiency	Water	Fans	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	24836071	11	###########	22%	100%	-$0.02	4,562
Electric	Energy Efficiency	Water	Motors Other	Retrofit	Integrated Plant Energy Management	Integrated Plant Energy Management		Existing	Per Industry	24836071	11	###########	22%	100%	-$0.02	4,562
Electric	Energy Efficiency	Water	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	2830344	10	$602,863.37	15%	100%	$0.02	269
Electric	Energy Efficiency	Water	Pumps	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	1605564	10	$369,279.77	17%	100%	$0.02	181
Electric	Energy Efficiency	Water	Fans	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	248361	10	$57,122.96	17%	100%	$0.02	26
Electric	Energy Efficiency	Water	Motors Other	Retrofit	Motors: Rewind 101-200 HP	Motors: Rewind 101-200 HP		Existing	Per Industry	248361	10	$57,122.96	17%	100%	$0.02	31
Electric	Energy Efficiency	Water	Pumps	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	2890016	10	###########	11%	100%	$0.04	182
Electric	Energy Efficiency	Water	Fans	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	447049	10	$160,937.74	11%	100%	$0.04	25
Electric	Energy Efficiency	Water	Motors Other	Retrofit	Motors: Rewind 20-50 HP	Motors: Rewind 20-50 HP		Existing	Per Industry	447049	10	$160,937.74	11%	100%	$0.04	33
Electric	Energy Efficiency	Water	Pumps	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	1605564	10	$497,724.90	0%	100%	$0.03	2

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Water	Fans	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	248361	10	$76,991.82	0%	100%	$0.03	0
Electric	Energy Efficiency	Water	Motors Other	Retrofit	Motors: Rewind 51-100 HP	Motors: Rewind 51-100 HP		Existing	Per Industry	248361	10	$76,991.82	0%	100%	$0.03	0
Electric	Energy Efficiency	Water	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	38533541	10	$806,507.01	27%	100%	$0.02	7,124
Electric	Energy Efficiency	Water	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	5960657	10	$124,756.55	27%	100%	$0.02	990
Electric	Energy Efficiency	Water	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	5960657	10	$124,756.55	27%	100%	$0.02	1,194
Electric	Energy Efficiency	Water	Pumps	Retrofit	Pump Energy Management	Pump Energy Management		Existing	Per Industry	24083463	10	$0.00	31%	100%	$0.01	4,948
Electric	Energy Efficiency	Water	Pumps	Retrofit	Pump Equipment Upgrade	Pump Equipment Upgrade		Existing	Per Industry	64222568	10	###########	34%	100%	$0.03	12,790
Electric	Energy Efficiency	Water	Pumps	Retrofit	Pump System Optimization	Pump System Optimization		Existing	Per Industry	160556420	12	###########	15%	100%	-$0.03	20,687
Electric	Energy Efficiency	Water	Pumps	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	6422257	10	###########	21%	100%	$0.02	872
Electric	Energy Efficiency	Water	Fans	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	993443	10	$212,527.57	21%	100%	$0.02	124
Electric	Energy Efficiency	Water	Motors Other	Retrofit	Synchronous Belts	Synchronous Belts		Existing	Per Industry	993443	10	$212,527.57	21%	100%	$0.02	150
Electric	Energy Efficiency	Water	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	4816693	10	$478,672.70	9%	100%	$0.00	310
Electric	Energy Efficiency	Water	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	745082	10	$74,044.68	9%	100%	$0.00	44
Electric	Energy Efficiency	Water	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	745082	10	$74,044.68	9%	100%	$0.00	52
Electric	Energy Efficiency	Water	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	150522	10	$14,958.52	9%	100%	$0.00	9
Electric	Energy Efficiency	Water	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	1053652	10	$104,709.65	9%	100%	$0.00	82
Electric	Energy Efficiency	Water	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1316563	32	###########	37%	100%	$0.06	271
Electric	Energy Efficiency	Water	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	203656	32	$154,778.40	37%	100%	$0.06	38
Electric	Energy Efficiency	Water	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	203656	32	$154,778.40	37%	100%	$0.06	50
Electric	Energy Efficiency	Water	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	41143	32	$31,268.36	37%	100%	$0.06	9
Electric	Energy Efficiency	Water	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	287998	32	$218,878.54	37%	100%	$0.06	89
Electric	Energy Efficiency	Computer Electronic Mfg	Hvac	Retrofit	Clean Room: Change Filter Strategy	Clean Room: Change Filter Strategy		Existing	Per Industry	5725006	1	$37,137.84	10%	100%	-$0.01	478
Electric	Energy Efficiency	Computer Electronic Mfg	Hvac	Retrofit	Clean Room: Chiller Optimize	Clean Room: Chiller Optimize		Existing	Per Industry	2121521	10	$172,763.97	28%	100%	$0.00	482
Electric	Energy Efficiency	Computer Electronic Mfg	Hvac	Retrofit	Clean Room: Clean Room HVAC	Clean Room: Clean Room HVAC		Existing	Per Industry	1288126	20	$208,545.88	30%	100%	$0.00	297
Electric	Energy Efficiency	Computer Electronic Mfg	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	395340	10	$8,274.46	27%	100%	$0.02	89
Electric	Energy Efficiency	Computer Electronic Mfg	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	96527	10	$7,770.40	26%	100%	$0.02	21
Electric	Energy Efficiency	Computer Electronic Mfg	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	1666112	10	$354,881.77	15%	100%	$0.02	213
Electric	Energy Efficiency	Computer Electronic Mfg	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	13507	32	$10,265.65	37%	100%	$0.06	4
Electric	Energy Efficiency	Computer Electronic Mfg	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	249291	10	$5,217.65	27%	100%	$0.02	56

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Computer Electronic Mfg	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	57916	10	$1,212.18	27%	100%	$0.02	13
Electric	Energy Efficiency	Computer Electronic Mfg	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	493545	10	$10,329.90	27%	100%	$0.02	111
Electric	Energy Efficiency	Computer Electronic Mfg	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	463776	10	$9,706.84	27%	100%	$0.02	104
Electric	Energy Efficiency	Computer Electronic Mfg	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	8517	32	$6,473.25	37%	100%	$0.06	3
Electric	Energy Efficiency	Computer Electronic Mfg	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1979	32	$1,503.89	37%	100%	$0.06	1
Electric	Energy Efficiency	Computer Electronic Mfg	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	16863	32	$12,815.72	37%	100%	$0.06	5
Electric	Energy Efficiency	Computer Electronic Mfg	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	15846	32	$12,042.73	37%	100%	$0.06	5
Electric	Energy Efficiency	Computer Electronic Mfg	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	22652	32	$17,215.41	37%	100%	$0.06	7
Electric	Energy Efficiency	Computer Electronic Mfg	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	58681	32	$44,597.80	37%	100%	$0.06	16
Electric	Energy Efficiency	Computer Electronic Mfg	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	24219	32	$18,406.45	37%	100%	$0.06	7
Electric	Energy Efficiency	Computer Electronic Mfg	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	16361	32	$12,433.99	37%	100%	$0.06	5
Electric	Energy Efficiency	Computer Electronic Mfg	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	49417	10	$4,911.00	9%	100%	$0.00	4
Electric	Energy Efficiency	Computer Electronic Mfg	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	31161	10	$3,096.75	9%	100%	$0.00	2
Electric	Energy Efficiency	Computer Electronic Mfg	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	7239	10	$719.45	9%	100%	$0.00	1
Electric	Energy Efficiency	Computer Electronic Mfg	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	61693	10	$6,130.93	9%	100%	$0.00	5
Electric	Energy Efficiency	Computer Electronic Mfg	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	57972	10	$5,761.14	9%	100%	$0.00	5
Electric	Energy Efficiency	Computer Electronic Mfg	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	82873	10	$8,235.71	9%	100%	$0.00	6
Electric	Energy Efficiency	Computer Electronic Mfg	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	214688	10	$21,335.21	9%	100%	$0.00	15
Electric	Energy Efficiency	Computer Electronic Mfg	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	88606	10	$8,805.49	9%	100%	$0.00	7
Electric	Energy Efficiency	Computer Electronic Mfg	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	59856	10	$5,948.32	9%	100%	$0.00	5
Electric	Energy Efficiency	Electrical Equipment Mfg	Hvac	Retrofit	Clean Room: Change Filter Strategy	Clean Room: Change Filter Strategy		Existing	Per Industry	836752	1	$5,427.97	10%	100%	-$0.01	70
Electric	Energy Efficiency	Electrical Equipment Mfg	Hvac	Retrofit	Clean Room: Chiller Optimize	Clean Room: Chiller Optimize		Existing	Per Industry	310076	10	$25,250.72	28%	100%	$0.00	70
Electric	Energy Efficiency	Electrical Equipment Mfg	Hvac	Retrofit	Clean Room: Clean Room HVAC	Clean Room: Clean Room HVAC		Existing	Per Industry	188269	20	$30,480.51	30%	100%	$0.00	43
Electric	Energy Efficiency	Electrical Equipment Mfg	Pumps	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	165682	10	$3,467.73	27%	100%	$0.02	37
Electric	Energy Efficiency	Electrical Equipment Mfg	Process Aircomp	Retrofit	Air Compressor Demand Reduction	Air Compressor Demand Reduction		Existing	Per Industry	294192	10	$23,682.47	26%	100%	$0.02	64
Electric	Energy Efficiency	Electrical Equipment Mfg	Lighting	Retrofit	Lighting Controls	Lighting Controls		Existing	Per Industry	469791	10	$100,065.50	15%	100%	$0.02	60
Electric	Energy Efficiency	Electrical Equipment Mfg	Pumps	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	5661	32	$4,302.22	37%	100%	$0.06	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Fans	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	75831	10	$1,587.15	27%	100%	$0.02	17
Electric	Energy Efficiency	Electrical Equipment Mfg	Process Aircomp	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	176515	10	$3,694.47	27%	100%	$0.02	40

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [kWh]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/kWh]	2035 Cumulative Technical Achievable Potential [MWh]
Electric	Energy Efficiency	Electrical Equipment Mfg	Motors Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	170143	10	$3,561.09	27%	100%	$0.02	38
Electric	Energy Efficiency	Electrical Equipment Mfg	Process Other	Retrofit	Plant Energy Management	Plant Energy Management		Existing	Per Industry	55483	10	$1,161.25	27%	100%	$0.02	12
Electric	Energy Efficiency	Electrical Equipment Mfg	Fans	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	2591	32	$1,969.09	37%	100%	$0.06	1
Electric	Energy Efficiency	Electrical Equipment Mfg	Process Aircomp	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	6031	32	$4,583.51	37%	100%	$0.06	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Motors Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	5813	32	$4,418.04	37%	100%	$0.06	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Process Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	1896	32	$1,440.70	37%	100%	$0.06	1
Electric	Energy Efficiency	Electrical Equipment Mfg	Process Heat	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	13325	32	$10,127.08	37%	100%	$0.06	4
Electric	Energy Efficiency	Electrical Equipment Mfg	Hvac	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	8577	32	$6,518.30	37%	100%	$0.06	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Lighting	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	6829	32	$5,190.04	37%	100%	$0.06	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Other	Retrofit	Transformers-New	Transformers-New		Existing	Per Industry	2155	32	$1,637.48	37%	100%	$0.06	1
Electric	Energy Efficiency	Electrical Equipment Mfg	Pumps	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	20710	10	$2,058.14	9%	100%	$0.00	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Fans	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	9479	10	$942.00	9%	100%	$0.00	1
Electric	Energy Efficiency	Electrical Equipment Mfg	Process Aircomp	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	22064	10	$2,192.71	9%	100%	$0.00	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Motors Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	21268	10	$2,113.56	9%	100%	$0.00	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Process Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	6935	10	$689.22	9%	100%	$0.00	1
Electric	Energy Efficiency	Electrical Equipment Mfg	Process Heat	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	48750	10	$4,844.71	9%	100%	$0.00	4
Electric	Energy Efficiency	Electrical Equipment Mfg	Hvac	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	31378	10	$3,118.30	9%	100%	$0.00	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Lighting	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	24984	10	$2,482.87	9%	100%	$0.00	2
Electric	Energy Efficiency	Electrical Equipment Mfg	Other	Retrofit	Transformers-Retrofit	Transformers-Retrofit		Existing	Per Industry	7883	10	$783.36	9%	100%	$0.00	1
Electric	Energy Efficiency	Street Lighting	Lighting - Street	Retrofit	LED Street Lighting Conversions	LED Street Lighting Conversions		Existing	Per Industry	37081794	12	$45,498,276	100%	89%	$0.16	27,480

Table 4 – Residential Gas Measure Detail

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Manufactured	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	Existing	Per Cooking Oven	6	20	$125.67	100%	100%	$2.41	1,400
Gas	Energy Efficiency	Manufactured	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	New	Per Cooking Oven	6	20	$125.67	100%	100%	$2.41	178
Gas	Energy Efficiency	Manufactured	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced Efficiency Dryer - EF 3.63	Federal Standard 2015 Dryer - EF 3.30	Existing	Per Dryer	2	11	$46.56	100%	100%	$3.26	295
Gas	Energy Efficiency	Manufactured	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced Efficiency Dryer - EF 3.63	Federal Standard 2015 Dryer - EF 3.30	New	Per Dryer	2	11	$46.56	100%	100%	$3.26	32
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Equipment	Furnace - Advanced Efficiency	Advanced Efficiency Furnace - 95% AFUE	Federal Standard 2007 Furnace - 78% AFUE	Existing	Per Gas Furnace	79	20	$328.13	90%	89%	$0.36	14,934
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2007 Furnace - 78% AFUE	Existing	Per Gas Furnace	86	20	$1,306.16	10%	99%	$1.61	1,998
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Equipment	Furnace - Advanced Efficiency	Advanced Efficiency Furnace - 95% AFUE	Federal Standard 2007 Furnace - 78% AFUE	New	Per Gas Furnace	39	20	$253.03	90%	89%	$0.62	1,311
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2007 Furnace - 78% AFUE	New	Per Gas Furnace	43	20	$1,007.20	10%	99%	$2.55	175
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Water Heater GT 55 Gal	19	15	$996.41	100%	99%	$6.74	884
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Water Heater GT 55 Gal	94	20	$4,264.89	15%	100%	$5.54	990
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Water Heater GT 55 Gal	19	15	$996.41	100%	99%	$6.74	59
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Water Heater GT 55 Gal	94	20	$4,264.89	15%	100%	$5.54	61
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Water Heater LE 55 Gal	62	15	$1,299.46	100%	100%	$2.64	32,394
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Water Heater LE 55 Gal	122	20	$5,791.72	15%	100%	$5.67	7,714
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Water Heater LE 55 Gal	62	15	$1,299.46	100%	100%	$2.64	2,290
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Water Heater LE 55 Gal	122	20	$5,791.72	15%	100%	$5.67	758
Gas	Energy Efficiency	Multifamily	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	Existing	Per Cooking Oven	6	20	$125.67	100%	100%	$2.41	17,183
Gas	Energy Efficiency	Multifamily	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	New	Per Cooking Oven	6	20	$125.67	100%	100%	$2.41	5,406
Gas	Energy Efficiency	Multifamily	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced Efficiency Dryer - EF 3.63	Federal Standard 2015 Dryer - EF 3.30	Existing	Per Dryer	2	11	$46.56	100%	100%	$3.26	3,306
Gas	Energy Efficiency	Multifamily	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced Efficiency Dryer - EF 3.63	Federal Standard 2015 Dryer - EF 3.30	New	Per Dryer	2	11	$46.56	100%	100%	$3.26	782
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Equipment	Boiler - Advanced Efficiency	Advanced Efficiency Boiler - 98% AFUE	Federal Standard 2012 Boiler - 82% AFUE	Existing	Per Boiler	103	20	$1,982.97	100%	100%	$2.08	8,107
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Equipment	Boiler - Advanced Efficiency	Advanced Efficiency Boiler - 98% AFUE	Federal Standard 2012 Boiler - 82% AFUE	New	Per Boiler	65	20	$1,528.89	100%	100%	$2.56	4,623
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Equipment	Furnace - Advanced Efficiency	Advanced Efficiency Furnace - 95% AFUE	Federal Standard 2007 Furnace - 78%	Existing	Per Gas Furnace	65	20	$283.27	90%	89%	$0.38	145,973

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
							AFUE									
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2007 Furnace - 78% AFUE	Existing	Per Gas Furnace	71	20	$1,127.58	10%	99%	$1.68	19,525
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Equipment	Furnace - Advanced Efficiency	Advanced Efficiency Furnace - 95% AFUE	Federal Standard 2007 Furnace - 78% AFUE	New	Per Gas Furnace	41	20	$227.90	90%	89%	$0.52	70,789
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2007 Furnace - 78% AFUE	New	Per Gas Furnace	45	20	$907.17	10%	99%	$2.20	9,469
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Water Heater GT 55 Gal	20	15	$996.41	100%	99%	$6.58	12,731
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Water Heater GT 55 Gal	76	20	$4,264.89	15%	100%	$6.86	11,259
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Water Heater GT 55 Gal	20	15	$996.41	100%	99%	$6.58	2,067
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Water Heater GT 55 Gal	76	20	$4,264.89	15%	100%	$6.86	1,701
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Water Heater LE 55 Gal	64	15	$1,299.46	100%	100%	$2.57	748,903
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Water Heater LE 55 Gal	99	20	$5,791.72	15%	100%	$7.02	142,985
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Water Heater LE 55 Gal	64	15	$1,299.46	100%	100%	$2.57	129,372
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Water Heater LE 55 Gal	99	20	$5,791.72	15%	100%	$7.02	33,760
Gas	Energy Efficiency	Single Family	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	Existing	Per Cooking Oven	6	20	$125.67	100%	100%	$2.41	199,098
Gas	Energy Efficiency	Single Family	Cooking Oven	Equipment	Cooking Oven - High Efficiency	High Efficiency Cooking Oven	Federal Standard 2012 Cooking Oven	New	Per Cooking Oven	6	20	$125.67	100%	100%	$2.41	143,315
Gas	Energy Efficiency	Single Family	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced Efficiency Dryer - EF 3.63	Federal Standard 2015 Dryer - EF 3.30	Existing	Per Dryer	2	11	$46.56	100%	100%	$3.26	151,268
Gas	Energy Efficiency	Single Family	Dryer	Equipment	Dryer - Advanced Efficiency	Advanced Efficiency Dryer - EF 3.63	Federal Standard 2015 Dryer - EF 3.30	New	Per Dryer	2	11	$46.56	100%	100%	$3.26	63,106
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Equipment	Boiler - Advanced Efficiency	Advanced Efficiency Boiler - 98% AFUE	Federal Standard 2012 Boiler - 82% AFUE	Existing	Per Boiler	145	20	$1,568.90	100%	100%	$1.12	287,053
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Equipment	Boiler - Advanced Efficiency	Advanced Efficiency Boiler - 98% AFUE	Federal Standard 2012 Boiler - 82% AFUE	New	Per Boiler	77	20	$1,220.28	100%	100%	$1.69	110,979
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Equipment	Furnace - Advanced Efficiency	Advanced Efficiency Furnace - 95% AFUE	Federal Standard 2007 Furnace - 78% AFUE	Existing	Per Gas Furnace	129	20	$461.34	90%	89%	$0.29	8,398,447
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2007 Furnace - 78% AFUE	Existing	Per Gas Furnace	141	20	$1,836.39	10%	99%	$1.37	1,123,371
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Equipment	Furnace - Advanced Efficiency	Advanced Efficiency Furnace - 95% AFUE	Federal Standard 2007 Furnace - 78% AFUE	New	Per Gas Furnace	64	20	$357.74	90%	89%	$0.52	2,829,528
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2007 Furnace - 78% AFUE	New	Per Gas Furnace	70	20	$1,424.01	10%	99%	$2.21	378,476
Gas	Energy Efficiency	Single Family	Pool Heat	Equipment	Pool Heater - Efficient	Efficient Pool Heater - 88% Efficient	Federal Standard 2013 Pool Heater - 82% Efficient	Existing	Per Pool Heater	15	8	$0.00	100%	100%	-$0.08	92,455

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Single Family	Pool Heat	Equipment	Pool Heater - Efficient	Efficient Pool Heater - 88% Efficient	Federal Standard 2013 Pool Heater - 82% Efficient	New	Per Pool Heater	15	8	$0.00	100%	100%	-$0.08	32,271
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Water Heater GT 55 Gal	23	15	$996.41	100%	99%	$5.66	771,799
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Water Heater GT 55 Gal	111	20	$4,264.89	15%	100%	$4.64	864,436
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Water Heater GT 55 Gal	23	15	$996.41	100%	99%	$5.66	272,346
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Water Heater GT 55 Gal	111	20	$4,264.89	15%	100%	$4.64	283,676
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Water Heater LE 55 Gal	74	15	$1,299.46	100%	100%	$2.21	16,815,772
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Water Heater LE 55 Gal	145	20	$5,791.72	15%	100%	$4.75	3,962,677
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Water Heater LE 55 Gal	74	15	$1,299.46	100%	100%	$2.21	6,365,646
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Water Heater LE 55 Gal	145	20	$5,791.72	15%	100%	$4.75	2,108,102
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	Existing	Per Home	15	20	$1,486.19	25%	95%	$11.19	3,715
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	Existing	Per Home	15	20	$1,486.19	50%	95%	$10.96	64,556
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Air-to-Air Heat Exchangers	Air-to-Air Heat Exchangers	No Air to Air Heat Exchangers	Existing	Per Home	4	20	$1,486.19	50%	95%	$40.38	700,813
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	161	45	$1,944.00	75%	1%	$1.09	2,235
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	216	45	$2,082.17	85%	0%	$0.84	9,399
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-0 (Zero Insulation - Single Family and Manufactured Homes Only)	Existing	Per Home	185	45	$2,082.17	85%	0%	$0.98	328,683
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-8.0 (Existing Insulation - Manufactured Homes Only)	Existing	Per Home	74	45	$1,944.00	75%	13%	$2.51	8,583
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-11.9 (Existing Insulation - Single Family Only)	Existing	Per Home	63	45	$2,082.17	85%	13%	$3.20	64,819
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Ceiling Insulation	R-49 (WA Code - Single Family and Manufactured Homes Only)	R-11.9 (Existing Insulation - Single Family Only)	Existing	Per Home	55	45	$2,082.17	85%	13%	$3.65	2,282,522
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	6	45	$1,188.00	40%	96%	$18.44	2,556
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	7	45	$1,188.00	60%	95%	$16.66	356

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	7	45	$1,272.43	75%	96%	$18.32	43,930
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	7	45	$1,094.89	90%	95%	$16.78	17,218
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	Existing	Per Home	6	45	$1,272.43	75%	96%	$20.80	1,574,284
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Ceiling Insulation	R-60 (Above WA Code - Single Family and Manufactured Homes Only)	R-49 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	5	45	$1,094.89	90%	95%	$20.09	522,331
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-0 (Zero Insulation - Multi Family Only)	Existing	Per Home	40	25	$433.19	50%	7%	$1.10	512
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-0 (Zero Insulation - Multi Family Only)	Existing	Per Home	21	25	$433.19	50%	7%	$2.20	9,122
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-9.6 (Existing Insulation - Multi Family Only)	Existing	Per Home	8	25	$433.19	50%	7%	$5.65	100
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Ceiling Insulation	R-38 (WA Code - Multi Family Only)	R-9.6 (Existing Insulation - Multi Family Only)	Existing	Per Home	4	25	$433.19	50%	7%	$10.95	1,802
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	Existing	Per Home	1	25	$54.14	15%	95%	$4.71	63
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	New	Per Home	3	25	$54.14	25%	80%	$1.74	115
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	Existing	Per Home	1	25	$54.14	15%	95%	$9.12	1,147
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Ceiling Insulation	R-49 (Above WA Code - Multi Family Only)	R-38 (WA Code - Multi Family Only)	New	Per Home	2	25	$54.14	25%	80%	$3.26	1,782
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	83	45	$1,566.00	25%	25%	$1.81	6,391
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	112	25	$392.57	25%	4%	$0.28	469
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	63	25	$392.57	25%	4%	$0.61	9,064
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	150	45	$1,677.29	25%	29%	$1.03	110,987
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Floor Insulation	R-30 (WA Code)	R-0 (Zero Insulation)	Existing	Per Home	103	45	$1,677.29	25%	29%	$1.56	3,111,419
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Floor Insulation	R-30 (WA Code)	R-6.7 (Existing Insulation: Manufactured Homes)	Existing	Per Home	43	45	$1,566.00	25%	50%	$3.54	6,019
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Floor Insulation	R-30 (WA Code)	R-5.2 (Existing Insulation: Multifamily)	Existing	Per Home	60	25	$392.57	25%	17%	$0.63	1,015
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Floor Insulation	R-30 (WA Code)	R-5.2 (Existing Insulation: Multifamily)	Existing	Per Home	34	25	$392.57	25%	17%	$1.22	19,623
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Floor Insulation	R-30 (WA Code)	R-8.5 (Existing Insulation: Single Family)	Existing	Per Home	63	45	$1,677.29	25%	41%	$2.58	61,617
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Floor Insulation	R-30 (WA Code)	R-8.5 (Existing Insulation: Single Family)	Existing	Per Home	43	45	$1,677.29	25%	41%	$3.84	1,664,688
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	6	45	$256.50	25%	85%	$4.04	1,451

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	6	45	$256.50	75%	85%	$3.93	416
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	6	25	$64.30	25%	69%	$1.12	383
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	7	25	$64.30	75%	85%	$0.95	760
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	3	25	$64.30	25%	69%	$2.10	7,400
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	4	25	$64.30	75%	85%	$1.81	12,089
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	10	45	$274.74	25%	84%	$2.77	19,209
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	9	45	$236.40	75%	85%	$2.58	21,797
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	Existing	Per Home	7	45	$274.74	25%	84%	$4.14	518,099
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Floor Insulation	R-38 (Above WA Code)	R-30 (WA Code)	New	Per Home	7	45	$236.40	75%	85%	$3.53	585,790
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Slab Insulation	R-10 with R-5 Thermal Break (Above WA Code)	R-10 (WA Code)	New	Per Home	5	45	$1,782.00	75%	75%	$36.11	232
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Slab Insulation	R-10 with R-5 Thermal Break (Above WA Code)	R-10 (WA Code)	New	Per Home	10	45	$1,642.32	75%	75%	$16.31	17,308
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Slab Insulation	R-10 with R-5 Thermal Break (Above WA Code)	R-10 (WA Code)	New	Per Home	8	45	$1,642.32	75%	75%	$19.51	525,076
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	139	45	$3,083.67	60%	9%	$2.12	9,034
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	102	25	$1,028.44	60%	2%	$1.02	408
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	57	25	$1,028.44	60%	2%	$1.92	7,894
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	265	45	$4,083.70	60%	23%	$1.43	375,461
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Wall Insulation 2x4	R-13 (Below WA Code - Maximum Insulation Feasible)	R-0 (Zero Insulation)	Existing	Per Home	219	45	$4,083.70	60%	23%	$1.75	12,643,943
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	19	45	$1,417.18	75%	95%	$7.53	1,329
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	34	45	$1,876.77	75%	95%	$5.40	89,214
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Wall Insulation 2x6	R-21 + R-5 sheathing (Above WA Code - Single Family and Manufactured Homes Only)	R-21 (WA Code - Single Family and Manufactured Homes Only)	New	Per Home	27	45	$1,876.77	75%	95%	$6.82	2,562,480
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	Existing	Per Clothes Washer	4	14	$208.84	100%	32%	$4.83	8
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	New	Per Clothes Washer	4	14	$208.84	100%	100%	$4.83	1

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	Existing	Per Clothes Washer	4	14	$208.84	100%	32%	$4.83	98
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	New	Per Clothes Washer	4	14	$208.84	100%	100%	$4.83	9
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	Existing	Per Clothes Washer	10	14	$586.86	15%	95%	$4.83	145
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	New	Per Clothes Washer	10	14	$586.86	15%	100%	$4.83	15
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	Existing	Per Clothes Washer	10	14	$586.86	15%	95%	$4.83	2,720
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	New	Per Clothes Washer	10	14	$586.86	15%	100%	$4.83	225
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	Existing	Per Clothes Washer	6	14	$356.13	100%	100%	$4.83	33,647
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	New	Per Clothes Washer	6	14	$356.13	100%	100%	$4.83	6,987
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	Existing	Per Clothes Washer	6	14	$356.13	100%	100%	$4.83	232,949
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2016 Clothes Washer - MEF 2.64 and WF 3.9 (Gas DHW & Dryer)	New	Per Clothes Washer	6	14	$356.13	100%	100%	$4.83	38,243
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	Existing	Per Clothes Washer	3	14	$187.86	100%	100%	$4.88	150
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	New	Per Clothes Washer	3	14	$187.86	100%	100%	$4.88	10
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	Existing	Per Clothes Washer	3	14	$187.86	100%	100%	$4.88	1,826
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	New	Per Clothes Washer	3	14	$187.86	100%	100%	$4.88	90

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	Existing	Per Clothes Washer	10	14	$527.91	15%	100%	$4.88	886
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	New	Per Clothes Washer	10	14	$527.91	15%	100%	$4.88	145
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	Existing	Per Clothes Washer	10	14	$527.91	15%	100%	$4.88	17,356
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	New	Per Clothes Washer	10	14	$527.91	15%	100%	$4.88	2,161
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	Existing	Per Clothes Washer	6	14	$320.35	100%	100%	$4.88	192,035
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	New	Per Clothes Washer	6	14	$320.35	100%	100%	$4.88	66,720
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	Existing	Per Clothes Washer	6	14	$320.35	100%	100%	$4.88	1,386,413
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Clothes Washer	ENERGY STAR - Most Efficient (3.2 MEF or higher) - Gas DHW & Dryer	RTF Market Standard 2018 Clothes Washer - MEF 2.68 and WF 3.7 (Gas DHW & Dryer)	New	Per Clothes Washer	6	14	$320.35	100%	100%	$4.88	365,882
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	3	15	$25.80	95%	75%	$1.15	86
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	3	15	$25.80	95%	75%	$1.15	1,046
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	3	15	$25.80	95%	17%	$1.15	273
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	3	15	$25.80	95%	17%	$1.15	5,356
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	3	15	$25.80	95%	72%	$1.15	60,610
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Hot Water Pipe Insulation	R-4 Wrap	No insulation	Existing	Per DWH Pipe Insulation	3	15	$25.80	95%	72%	$1.15	439,642
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	20
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	2
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	241
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	15
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	284

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	55
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	5,590
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	838
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	14,551
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	6,200
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	Existing	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	105,536
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Water Heater Tank Blanket/Insulation	Install Insulation (R-5)	No Tank Insulation	New	Per Tank Wrap per Gallon DWH Storage	3	10	$63.10	95%	20%	$3.93	35,061
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	0	15	$4.49	100%	50%	-$0.02	8
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	0	15	$4.49	100%	50%	-$0.02	1
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	0	15	$4.49	100%	50%	-$0.02	96
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	0	15	$4.49	100%	50%	-$0.02	6
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	1	15	$7.25	100%	50%	-$0.04	179
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	1	15	$7.25	100%	50%	-$0.04	36
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	1	15	$7.25	100%	50%	-$0.04	3,501
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	1	15	$7.25	100%	50%	-$0.04	541
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	0	15	$6.34	100%	50%	-$0.03	8,365
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	0	15	$6.34	100%	50%	-$0.03	3,611
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	Existing	Per Dishwasher	0	15	$6.34	100%	50%	-$0.03	60,394
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Dishwasher	RTF ENERGY STAR Dishwasher - 271 kWh/yr and 3.56 gal/cycle	RTF Market Standard 2014 Dishwasher - 277 kWh/yr and 3.82 gal/cycle	New	Per Dishwasher	0	15	$6.34	100%	50%	-$0.03	19,800

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	Existing	Per Door	3	20	$29.11	15%	95%	$1.07	495
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	New	Per Door	3	20	$29.11	15%	95%	$1.15	42
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	Existing	Per Door	10	20	$71.91	15%	100%	$0.74	14,812
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	New	Per Door	9	20	$71.91	15%	95%	$0.76	5,205
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	Existing	Per Door	8	20	$71.91	15%	100%	$0.92	508,622
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Single Family and Manufactured Homes Only)	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	New	Per Door	8	20	$71.91	15%	95%	$1.00	149,310
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Doors	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	R-2.5 (Standard non-thermal wood door) (Below WA Code - Single Family and Manufactured Homes Only)	Existing	Per Door	5	20	$49.32	15%	75%	$0.91	767
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Doors	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	R-2.5 (Standard non-thermal wood door) (Below WA Code - Single Family and Manufactured Homes Only)	Existing	Per Door	19	20	$121.82	15%	77%	$0.63	22,639
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Doors	R-5 (Composite Doors with foam core) (WA Code Single Family and Manufactured Homes Only)	R-2.5 (Standard non-thermal wood door) (Below WA Code - Single Family and Manufactured Homes Only)	Existing	Per Door	16	20	$121.82	15%	77%	$0.79	769,076
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	Existing	Per Door	22	20	$78.43	4%	18%	$0.28	60
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	21	20	$78.43	4%	80%	$0.31	111
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	Existing	Per Door	13	20	$78.43	4%	18%	$0.61	1,155
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Doors	R-10 (Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	12	20	$78.43	4%	80%	$0.67	1,770

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	Existing	Per Door	15	20	$49.32	21%	18%	$0.26	186
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	14	20	$49.32	21%	60%	$0.28	261
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	Existing	Per Door	8	20	$49.32	21%	18%	$0.57	3,600
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Doors	R-5 (Composite Doors with foam core) (Above WA Code - Multi-Family Only)	R-2.5 (Standard non-thermal wood door) (WA Code - Multi-Family Only)	New	Per Door	8	20	$49.32	21%	60%	$0.62	4,154
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	2	5	$30.22	13%	50%	$3.21	158
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	6	5	$30.22	13%	18%	$1.24	48
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	3	5	$30.22	13%	18%	$2.37	898
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	27	5	$74.65	13%	77%	$0.60	25,654
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Doors - Weatherization	Weatherstripping And Adding Door Sweeps	Existing Non-Efficient door	Existing	Per Door Weatherized	19	5	$74.65	13%	77%	$0.93	718,745
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	Existing	Per Home	14	40	$463.82	29%	89%	$3.31	162
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	14	40	$463.82	59%	90%	$3.31	18
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	Existing	Per Home	14	40	$463.82	29%	89%	$3.31	1,971
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	14	40	$463.82	59%	90%	$3.31	168
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	17	40	$463.82	59%	90%	$2.77	748
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	17	40	$463.82	59%	90%	$2.77	11,334
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	Existing	Per Home	17	40	$463.82	29%	90%	$2.70	145,726
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	17	40	$463.82	59%	90%	$2.70	86,454
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	Existing	Per Home	17	40	$463.82	29%	90%	$2.70	1,057,003
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Drain Water Heat Recovery	Drain Water Heat Recovery	No Drain Water Heat Recovery	New	Per Home	17	40	$463.82	59%	90%	$2.70	483,205
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Duct Location	Conditioned Space Design - Duct Loss Is Not A Concern	Ducts in Unconditioned Space (Duct loss)	New	Per Home	31	30	$278.00	75%	10%	$0.84	285
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Duct Location	Conditioned Space Design - Duct Loss Is Not A Concern	Ducts in Unconditioned Space (Duct loss)	New	Per Home	33	30	$278.00	75%	10%	$0.76	428,951
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Combined Duct Sealing and Insulation	Duct Sealing and R-8 Duct Insualtion	No Duct Sealing and Baseline Duct Insulation	Existing	Per Home	50	20	$1,029.00	50%	60%	$2.25	17,142
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Combined Duct Sealing and Insulation	Duct Sealing and R-8 Duct Insualtion	No Duct Sealing and Baseline Duct Insulation	Existing	Per Home	54	20	$1,454.65	50%	47%	$2.93	4,962,044

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	standard ducts with 13 SEER HVAC	Existing	Per Home	52	30	$128.42	5%	95%	$0.14	3,122
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	standard ducts with 13 SEER HVAC	New	Per Home	24	30	$128.42	15%	95%	$0.45	428
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	standard ducts with 13 SEER HVAC	Existing	Per Home	8	30	$128.42	5%	95%	$1.46	159,633
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands (5 per unit)	standard ducts with 13 SEER HVAC	New	Per Home	18	30	$128.42	15%	95%	$0.63	435,844
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	6	9	$0.00	100%	95%	-$2.95	275
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	3	9	$0.00	100%	95%	-$3.96	10
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	6	9	$0.00	100%	95%	-$3.18	3,092
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	3	9	$0.00	100%	95%	-$3.30	107
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	6	9	$0.00	100%	95%	-$2.95	4,057
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	4	9	$0.00	100%	95%	-$3.97	464
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	6	9	$0.00	100%	95%	-$3.18	73,397
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	4	9	$0.00	100%	95%	-$3.30	8,349
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	9	9	$0.00	100%	95%	-$2.95	304,103
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	3	9	$0.00	100%	95%	-$3.97	40,971
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	Existing	Per Faucet Aerator - Bathroom	8	9	$0.00	100%	95%	-$3.18	2,028,890
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	0.5 GPM - Bathroom	2.2 GPM - Bathroom	New	Per Faucet Aerator - Bathroom	3	9	$0.00	100%	95%	-$3.30	271,434
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	3	9	$12.35	100%	15%	-$2.19	20
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	3	9	$12.35	100%	15%	-$2.36	230
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	3	9	$9.49	100%	15%	-$2.39	301
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	3	9	$9.49	100%	15%	-$2.58	5,454
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	4	9	$17.11	100%	15%	-$2.23	22,596

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Bathroom	2.2 GPM - Bathroom	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Bathroom	4	9	$17.11	100%	15%	-$2.41	150,753
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	5	9	$0.00	100%	65%	-$4.38	145
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	3	9	$0.00	100%	65%	-$5.91	9
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	4	9	$0.00	100%	65%	-$4.73	1,633
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	4	9	$0.00	100%	65%	-$4.90	97
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	5	9	$0.00	100%	65%	-$4.38	2,143
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	4	9	$0.00	100%	65%	-$5.91	321
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	4	9	$0.00	100%	65%	-$4.73	38,772
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	4	9	$0.00	100%	65%	-$4.90	5,781
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	7	9	$0.00	100%	65%	-$4.38	160,643
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	5	9	$0.00	100%	65%	-$5.91	51,140
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	Existing	Per Faucet Aerator - Kitchen	6	9	$0.00	100%	65%	-$4.73	1,071,763
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	1.5 GPM - Kitchen	2.2 GPM - Kitchen	New	Per Faucet Aerator - Kitchen	6	9	$0.00	100%	65%	-$4.90	338,800
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	5	9	$7.24	100%	15%	-$4.14	38
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	5	9	$7.24	100%	15%	-$4.47	431
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	6	9	$7.24	100%	15%	-$4.15	565
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	5	9	$7.24	100%	15%	-$4.49	10,226
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	8	9	$7.24	100%	15%	-$4.22	42,367
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Faucet Aerators - Kitchen	2.2 GPM - Kitchen	Existing Faucet Aerator (3.0 GPM)	Existing	Per Faucet Aerator - Kitchen	7	9	$7.24	100%	15%	-$4.56	282,663
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	7	11	$1,782.00	64%	29%	$41.48	1,267
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	68	11	$1,744.20	64%	49%	$3.88	7,325
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	37	11	$1,744.20	64%	49%	$7.22	139,106

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	32	11	$3,850.20	64%	50%	$18.32	90,189
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Infiltration Control (Caulk, Weather Strip, etc.) Blower-Door test	Install Caulking And Weatherstripping	Existing Infiltration Conditions	Existing	Per Home	22	11	$3,850.20	64%	50%	$26.62	2,528,695
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	Existing	Per Integrated System	64	20	$1,780.00	15%	95%	$3.11	390
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	New	Per Integrated System	48	20	$1,780.00	15%	95%	$4.19	23
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	Existing	Per Integrated System	63	20	$1,780.00	15%	95%	$3.12	4,742
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	New	Per Integrated System	62	20	$1,780.00	15%	95%	$3.22	284
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	Existing	Per Integrated System	55	20	$1,780.00	15%	95%	$3.59	2,767
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	New	Per Integrated System	34	20	$1,780.00	15%	95%	$5.83	727
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	Existing	Per Integrated System	65	20	$1,780.00	15%	95%	$3.03	5,750
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	New	Per Integrated System	49	20	$1,780.00	15%	95%	$4.09	825
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	Existing	Per Integrated System	65	20	$1,780.00	15%	95%	$3.05	112,598
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	New	Per Integrated System	63	20	$1,780.00	15%	95%	$3.14	16,393
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	Existing	Per Integrated System	77	20	$1,780.00	15%	95%	$2.51	103,009
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	New	Per Integrated System	40	20	$1,780.00	15%	95%	$4.91	19,868
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	Existing	Per Integrated System	76	20	$1,780.00	15%	95%	$2.60	341,348
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	New	Per Integrated System	57	20	$1,780.00	15%	95%	$3.51	108,673
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	Existing	Per Integrated System	75	20	$1,780.00	15%	95%	$2.61	2,466,520
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating and Water Heating	90% CAE or Above	Standard Boiler and Water Heater	New	Per Integrated System	73	20	$1,780.00	15%	95%	$2.69	795,672
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	1	45	$795.60	75%	75%	$125.68	29
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	1	25	$795.60	40%	75%	$76.12	52
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	1	25	$795.60	40%	75%	$135.37	843
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Smart Siting	Siting house to minimize heating/cooling costs	No smart siting	New	Per Home	1	45	$795.60	75%	75%	$57.22	2,359
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Smart Siting	Siting house to minimize	No smart siting	New	Per Home	1	45	$795.60	75%	75%	$76.75	63,337

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
						heating/cooling costs										
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	58	45	$753.70	25%	95%	$1.20	1,652
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	22	25	$737.72	25%	95%	$3.67	792
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	12	25	$737.72	25%	95%	$6.68	12,539
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	61	45	$1,628.45	25%	95%	$2.57	54,974
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Construction - SIP	Specialty Framing	Standard Wood Framing	New	Per Home	49	45	$1,628.45	25%	95%	$3.26	1,586,348
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	23	45	$495.00	85%	95%	$2.03	2,114
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	22	25	$484.50	85%	95%	$2.36	3,089
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	13	25	$484.50	85%	95%	$4.23	50,112
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	100	45	$1,069.50	85%	95%	$0.96	380,141
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Thermal Shell - Infiltration @0.2 ACH w/HRV	0.2 ACH w/HRV	Standard New Construction Home 0.35 ACH	New	Per Home	75	45	$1,069.50	85%	95%	$1.34	10,244,065
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)	Existing	Per Showerhead	10	10	$0.00	95%	85%	-$1.57	403
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)	New	Per Showerhead	10	10	$0.00	95%	85%	-$1.57	253
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)	Existing	Per Showerhead	10	10	$0.00	95%	85%	-$1.57	5,416
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)	New	Per Showerhead	10	10	$0.00	95%	85%	-$1.57	13,838
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)	Existing	Per Showerhead	14	10	$0.00	95%	84%	-$1.57	413,322
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)	New	Per Showerhead	14	10	$0.00	95%	85%	-$1.57	835,488
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Thermostat - Multi-Zone	Individual Room Temperature Control for Major Occupied Rooms	Programmable Thermostat - Central Control Only	Existing	Per Home	28	10	$882.71	10%	95%	$4.93	2,886
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Thermostat - Multi-Zone	Individual Room Temperature Control for Major Occupied Rooms	Programmable Thermostat - Central Control Only	New	Per Home	14	10	$882.71	50%	95%	$10.08	568
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Thermostat - Multi-Zone	Individual Room Temperature Control for Major Occupied Rooms	Programmable Thermostat - Central Control Only	Existing	Per Home	58	10	$882.71	10%	95%	$2.31	51,221
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Thermostat - Multi-Zone	Individual Room Temperature Control for Major Occupied Rooms	Programmable Thermostat - Central Control Only	New	Per Home	31	10	$882.71	75%	95%	$4.53	74,093
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Thermostat - Multi-Zone	Individual Room Temperature Control for Major Occupied Rooms	Programmable Thermostat - Central Control Only	Existing	Per Home	46	10	$882.71	10%	95%	$2.96	1,624,277
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Thermostat - Multi-Zone	Individual Room Temperature Control for Major Occupied	Programmable Thermostat - Central Control Only	New	Per Home	23	10	$882.71	75%	95%	$6.12	2,003,116

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
						Rooms										
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	Existing	Per Home	10	10	$167.45	25%	52%	$2.66	826
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	New	Per Home	5	10	$167.45	100%	95%	$5.48	180
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	Existing	Per Home	20	10	$167.45	25%	79%	$1.22	22,832
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	New	Per Home	11	10	$167.45	100%	95%	$2.44	7,751
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	Existing	Per Home	16	10	$167.45	25%	86%	$1.58	796,918
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Wi-Fi Thermostat	WiFi Thermostat	Programmable Thermostat	New	Per Home	8	10	$167.45	100%	95%	$3.33	207,722
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	27	30	$2,208.72	50%	85%	$8.67	12,346
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	20	30	$2,208.72	70%	75%	$11.87	962
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	82	30	$2,262.36	50%	85%	$2.87	13,044
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	60	30	$2,573.22	70%	75%	$4.52	5,184
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	46	30	$2,262.36	50%	85%	$5.20	252,019
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	34	30	$2,573.22	70%	75%	$8.18	82,449
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	56	30	$3,556.83	50%	75%	$6.75	190,582
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	42	30	$3,384.67	70%	75%	$8.64	70,980
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	Existing	Per Home	47	30	$3,556.83	50%	75%	$8.12	6,417,582
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Windows	U-value = 0.22 (Above WA Code)	U-value = 0.30 (WA Code)	New	Per Home	33	30	$3,384.67	70%	75%	$10.93	2,052,255
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	132	30	$2,845.55	50%	15%	$2.21	11,702
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	306	30	$2,914.63	50%	9%	$0.91	5,426
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	173	30	$2,914.63	50%	9%	$1.73	104,806
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	271	30	$4,582.32	50%	15%	$1.72	195,128
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Windows	U-value = 0.30 (WA Code)	Double Pane (Existing Window)	Existing	Per Home	224	30	$4,582.32	50%	15%	$2.11	6,571,221
Gas	Energy Efficiency	Manufactured	Heat Central Furnace	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	166	30	$8,458.85	50%	5%	$5.40	4,509
Gas	Energy Efficiency	Multifamily	Heat Central Boiler	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	361	30	$8,664.22	50%	2%	$2.47	1,098
Gas	Energy Efficiency	Multifamily	Heat Central Furnace	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	203	30	$8,664.22	50%	2%	$4.51	21,223
Gas	Energy Efficiency	Single Family	Heat Central Boiler	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	338	30	$13,621.68	50%	5%	$4.24	74,915
Gas	Energy Efficiency	Single Family	Heat Central Furnace	Retrofit	Windows	U-value = 0.30 (WA Code)	Single Pane (Existing Window)	Existing	Per Home	279	30	$13,621.68	50%	5%	$5.17	2,498,609
Gas	Energy Efficiency	Manufactured	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)	Existing	Per Showerhead	10	10	$0.00	95%	85%	-$1.57	4,893
Gas	Energy Efficiency	Multifamily	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)	Existing	Per Showerhead	10	10	$0.00	95%	85%	-$1.57	106,049

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Single Family	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)	Existing	Per Showerhead	14	10	$0.00	95%	84%	-$1.57	2,984,014
Gas	Energy Efficiency	Manufactured	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.24 GPM (RBSA Baseline: Manufactured)	New	Per Showerhead	10	10	$0.00	95%	85%	-$1.57	27
Gas	Energy Efficiency	Multifamily	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Multifamily)	New	Per Showerhead	10	10	$0.00	95%	85%	-$1.57	929
Gas	Energy Efficiency	Single Family	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.14 GPM (RBSA Baseline: Single Family)	New	Per Showerhead	14	10	$0.00	95%	85%	-$1.57	152,351

Table 5 – Commercial Gas Measure Detail

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.07	50%	97%	$2.11	17,354
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.14	50%	99%	$2.24	34,102
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.04	50%	97%	$2.14	7,383
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.08	50%	99%	$2.27	14,506
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$2.66	70,747
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$2.90	107,622
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$3.11	141,253
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.13	10%	97%	$2.54	28,293
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.19	10%	99%	$2.78	43,039
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.24	10%	100%	$2.99	56,489
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.04	100%	97%	$2.27	17,427
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$0.38	3%	100%	$3.93	3,341
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.04	100%	97%	$2.15	6,965
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$0.38	3%	100%	$3.72	1,232
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.02	32%	93%	$1.41	39,630
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.09	32%	97%	$2.12	158,858
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.21	32%	97%	$3.98	184,235
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$0.92	3%	97%	$6.32	57,162
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.02	32%	93%	$1.33	15,953
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.09	32%	97%	$2.01	63,913
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.21	32%	97%	$3.77	74,148

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$0.92	3%	97%	$5.99	21,226
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.07	50%	97%	$0.56	401
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.14	50%	99%	$0.60	789
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.01	50%	97%	$0.33	58
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.03	50%	99%	$0.59	113
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$0.72	23,974
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$0.80	36,471
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$0.86	47,867
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.05	10%	97%	$0.69	3,224
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.08	10%	99%	$0.85	4,904
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.10	10%	100%	$0.91	6,436
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.08	100%	97%	$0.96	10,903
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$0.68	3%	100%	$1.51	2,090
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.08	100%	97%	$0.90	4,518
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$0.68	3%	100%	$1.42	799
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.05	32%	93%	$0.74	24,692
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.22	32%	97%	$1.11	98,979
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.49	32%	97%	$2.01	114,790
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$2.17	3%	97%	$3.26	35,615
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.05	32%	93%	$0.70	10,359
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.22	32%	97%	$1.05	41,502
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.49	32%	97%	$1.90	48,149

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$2.17	3%	97%	$3.08	13,783
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.07	50%	97%	$0.37	65,363
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.14	50%	99%	$0.40	128,439
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.07	50%	97%	$0.37	45,365
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.13	50%	99%	$0.37	89,139
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$0.49	50,414
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$0.54	76,692
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$0.59	100,658
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.24	10%	97%	$0.49	32,505
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.34	10%	99%	$0.53	49,447
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.43	10%	100%	$0.58	64,899
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.21	100%	97%	$0.74	88,474
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$1.81	3%	100%	$1.19	16,961
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.21	100%	97%	$0.70	35,632
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$1.81	3%	100%	$1.13	6,304
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.13	32%	93%	$0.56	201,225
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.59	32%	97%	$0.88	806,621
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$1.33	32%	97%	$1.63	935,474
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$5.93	3%	97%	$2.67	290,244
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.13	32%	93%	$0.53	81,633
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.59	32%	97%	$0.83	327,052
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$1.33	32%	97%	$1.54	379,428

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$5.93	3%	97%	$2.52	108,617
Gas	Energy Efficiency	Hotel Motel	Pool Heat	Equipment	RE - Installation of Solar Pool/Spa Heating Systems	Solar Pool/Spa Heating Systems	Standard Pool Heat Equipment	Existing	Per Sqft	0	12	$0.52	50%	100%	$7.15	53,917
Gas	Energy Efficiency	Hotel Motel	Pool Heat	Equipment	RE - Installation of Solar Pool/Spa Heating Systems	Solar Pool/Spa Heating Systems	Standard Pool Heat Equipment	New	Per Sqft	0	12	$0.52	50%	100%	$7.15	18,521
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.07	50%	97%	$0.82	12,192
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.14	50%	99%	$0.87	23,958
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.05	50%	97%	$0.80	5,110
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.10	50%	99%	$0.85	10,040
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$1.04	2,414
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$1.15	3,672
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$1.23	4,820
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.18	10%	97%	$1.08	1,183
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.26	10%	99%	$1.17	1,799
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.32	10%	100%	$1.23	2,362
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.20	100%	97%	$0.95	23,745
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$1.68	3%	100%	$1.48	4,552
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.20	100%	97%	$0.90	9,448
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$1.68	3%	100%	$1.40	1,671
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.12	32%	93%	$0.71	53,183
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.54	32%	97%	$1.08	213,187
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$1.22	32%	97%	$2.00	247,242
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$5.46	3%	97%	$3.27	76,710
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.12	32%	93%	$0.67	21,681

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.54	32%	97%	$1.02	86,861
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$1.22	32%	97%	$1.89	100,772
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$5.46	3%	97%	$3.09	28,847
Gas	Energy Efficiency	Office	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.07	50%	97%	$0.61	222,133
Gas	Energy Efficiency	Office	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.14	50%	99%	$0.65	436,489
Gas	Energy Efficiency	Office	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.03	50%	97%	$0.50	59,915
Gas	Energy Efficiency	Office	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.07	50%	99%	$0.65	117,730
Gas	Energy Efficiency	Office	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$0.78	159,853
Gas	Energy Efficiency	Office	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$0.86	243,173
Gas	Energy Efficiency	Office	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$0.93	319,163
Gas	Energy Efficiency	Office	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.11	10%	97%	$0.71	50,610
Gas	Energy Efficiency	Office	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.17	10%	99%	$0.83	76,989
Gas	Energy Efficiency	Office	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.21	10%	100%	$0.88	101,048
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.04	100%	97%	$1.75	36,064
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$0.34	3%	100%	$2.72	6,914
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.04	100%	97%	$1.66	14,517
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$0.34	3%	100%	$2.58	2,568
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.03	32%	93%	$1.67	82,059
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.12	32%	97%	$2.21	328,939
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.26	32%	97%	$3.85	381,485
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$1.12	3%	97%	$6.01	118,361
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.03	32%	93%	$1.57	33,246

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.12	32%	97%	$2.09	133,196
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.26	32%	97%	$3.64	154,527
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$1.12	3%	97%	$5.69	44,236
Gas	Energy Efficiency	Other Commercial	Pool Heat	Equipment	RE - Installation of Solar Pool/Spa Heating Systems	Solar Pool/Spa Heating Systems	Standard Pool Heat Equipment	Existing	Per Sqft	0	12	$0.76	50%	100%	$7.17	342,950
Gas	Energy Efficiency	Other Commercial	Pool Heat	Equipment	RE - Installation of Solar Pool/Spa Heating Systems	Solar Pool/Spa Heating Systems	Standard Pool Heat Equipment	New	Per Sqft	0	12	$0.76	50%	100%	$7.17	117,807
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.07	50%	97%	$0.97	95,367
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.14	50%	99%	$1.04	187,398
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.04	50%	97%	$1.09	29,213
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.07	50%	99%	$1.00	57,401
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$1.24	105,694
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$1.36	160,784
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$1.46	211,029
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.13	10%	97%	$1.31	38,125
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.18	10%	99%	$1.36	57,997
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.23	10%	100%	$1.48	76,121
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.05	100%	97%	$2.50	25,846
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$0.48	3%	100%	$4.37	4,955
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.05	100%	97%	$2.36	10,043
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$0.48	3%	100%	$4.13	1,777
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.03	32%	93%	$1.88	58,221
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.16	32%	97%	$3.36	233,381
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.35	32%	97%	$5.85	270,663

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$1.59	3%	97%	$9.62	83,977
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.03	32%	93%	$1.78	23,252
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.16	32%	97%	$3.18	93,155
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.35	32%	97%	$5.54	108,074
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$1.59	3%	97%	$9.12	30,938
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$4.41	3,750
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$4.81	5,705
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$5.15	7,488
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.19	10%	97%	$4.64	1,782
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.27	10%	99%	$4.93	2,711
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.34	10%	100%	$5.28	3,558
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.16	100%	97%	$0.52	29,204
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$1.37	3%	100%	$0.84	5,598
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.16	100%	97%	$0.48	11,210
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$1.37	3%	100%	$0.79	1,983
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.09	32%	93%	$0.35	65,552
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.44	32%	97%	$0.60	262,771
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$1.00	32%	97%	$1.15	304,747
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$4.47	3%	97%	$1.90	94,552
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.09	32%	93%	$0.32	26,111
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.44	32%	97%	$0.57	104,608
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$1.00	32%	97%	$1.08	121,361

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$4.47	3%	97%	$1.80	34,741
Gas	Energy Efficiency	School	Pool Heat	Equipment	RE - Installation of Solar Pool/Spa Heating Systems	Solar Pool/Spa Heating Systems	Standard Pool Heat Equipment	Existing	Per Sqft	0	12	$0.17	50%	100%	$1.60	135,390
Gas	Energy Efficiency	School	Pool Heat	Equipment	RE - Installation of Solar Pool/Spa Heating Systems	Solar Pool/Spa Heating Systems	Standard Pool Heat Equipment	New	Per Sqft	0	12	$0.17	50%	100%	$1.60	46,508
Gas	Energy Efficiency	School	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.07	50%	97%	$1.25	92,476
Gas	Energy Efficiency	School	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.14	50%	99%	$1.33	181,713
Gas	Energy Efficiency	School	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.06	50%	97%	$1.24	46,235
Gas	Energy Efficiency	School	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.12	50%	99%	$1.32	90,850
Gas	Energy Efficiency	School	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$1.58	13,523
Gas	Energy Efficiency	School	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$1.73	20,572
Gas	Energy Efficiency	School	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$1.86	27,001
Gas	Energy Efficiency	School	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.21	10%	97%	$1.61	7,904
Gas	Energy Efficiency	School	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.30	10%	99%	$1.72	12,024
Gas	Energy Efficiency	School	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.37	10%	100%	$1.81	15,781
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.05	100%	97%	$1.32	27,665
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$0.38	3%	100%	$1.83	5,304
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.05	100%	97%	$1.24	11,051
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$0.38	3%	100%	$1.73	1,955
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.02	32%	93%	$0.63	62,580
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.12	32%	97%	$1.32	250,854
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.27	32%	97%	$2.40	290,926
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$1.24	3%	97%	$4.02	90,264
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.02	32%	93%	$0.59	25,380

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.12	32%	97%	$1.24	101,680
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.27	32%	97%	$2.27	117,964
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$1.24	3%	97%	$3.81	33,769
Gas	Energy Efficiency	University	Pool Heat	Equipment	RE - Installation of Solar Pool/Spa Heating Systems	Solar Pool/Spa Heating Systems	Standard Pool Heat Equipment	Existing	Per Sqft	0	12	$0.16	50%	100%	$1.57	82,923
Gas	Energy Efficiency	University	Pool Heat	Equipment	RE - Installation of Solar Pool/Spa Heating Systems	Solar Pool/Spa Heating Systems	Standard Pool Heat Equipment	New	Per Sqft	0	12	$0.16	50%	100%	$1.57	28,485
Gas	Energy Efficiency	University	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.07	50%	97%	$0.57	119,673
Gas	Energy Efficiency	University	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.14	50%	99%	$0.61	235,155
Gas	Energy Efficiency	University	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.06	50%	97%	$0.57	59,259
Gas	Energy Efficiency	University	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.12	50%	99%	$0.61	116,441
Gas	Energy Efficiency	University	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$0.74	17,543
Gas	Energy Efficiency	University	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$0.81	26,688
Gas	Energy Efficiency	University	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$0.87	35,027
Gas	Energy Efficiency	University	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.21	10%	97%	$0.75	10,144
Gas	Energy Efficiency	University	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.30	10%	99%	$0.81	15,432
Gas	Energy Efficiency	University	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.37	10%	100%	$0.85	20,254
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.05	100%	97%	$0.74	30,320
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$0.39	3%	100%	$1.07	5,812
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.05	100%	97%	$0.70	12,163
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$0.39	3%	100%	$1.01	2,152
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.02	32%	93%	$0.34	68,766
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.12	32%	97%	$0.74	275,653
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.27	32%	97%	$1.38	319,687

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$1.24	3%	97%	$2.34	99,187
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.02	32%	93%	$0.31	27,901
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.12	32%	97%	$0.70	111,781
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.27	32%	97%	$1.30	129,682
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$1.24	3%	97%	$2.21	37,123
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.07	50%	97%	$1.73	2,489
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	Existing	Per Sqft	0	20	$0.14	50%	99%	$1.83	4,893
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Equipment	Boiler - High Efficiency	Boiler 85% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.03	50%	97%	$1.30	800
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Equipment	Boiler - Premium Efficiency	Boiler 90% Thermal Efficiency	Federal Standard 2012 Boiler - 80% Thermal Efficiency	New	Per Sqft	0	20	$0.07	50%	99%	$1.63	1,572
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.24	10%	97%	$2.18	68,015
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.35	10%	99%	$2.38	103,466
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	Existing	Per Sqft	0	18	$0.44	10%	100%	$2.55	135,799
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Equipment	Furnace - High Efficiency	High Efficiency Furnace - 90% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.14	10%	97%	$2.27	25,675
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Equipment	Furnace - Premium Efficiency	High Efficiency Furnace - 94% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.19	10%	99%	$2.30	39,057
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Equipment	Furnace - ENERGY STAR Most Efficient	ENERGY STAR Most Efficient Furnace - 97% AFUE	Federal Standard 2003 Furnace - 80% AFUE	New	Per Sqft	0	18	$0.24	10%	100%	$2.48	51,262
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	10	$0.01	100%	97%	$0.75	5,516
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	Existing	Per Sqft	0	20	$0.08	3%	100%	$1.11	1,057
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.85	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	10	$0.01	100%	97%	$0.70	2,227
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Condensing Water Heater - EF 0.743	New	Per Sqft	0	20	$0.08	3%	100%	$1.05	394
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.00	32%	93%	-$0.08	12,552
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.02	32%	97%	$0.61	50,317
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	10	$0.04	32%	97%	$1.01	58,355

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	Existing	Per Sqft	0	20	$0.19	3%	97%	$1.78	18,105
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Storage	ENERGY STAR Storage Water Heater - EF 0.67	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.00	32%	93%	-$0.08	5,100
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Water Heater - ENERGY STAR Tankless	ENERGY STAR Tankless Water Heater - EF 0.82	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.02	32%	97%	$0.57	20,431
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Water Heater - Condensing	Condensing Water Heater - EF 0.90	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	10	$0.04	32%	97%	$0.95	23,703
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Equipment	Solar Hot Water (SHW)	Solar Water Heater	Federal Standard 2015 Storage Water Heater - EF 0.615	New	Per Sqft	0	20	$0.19	3%	97%	$1.68	6,785
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	69	15	$2,875.00	25%	94%	$4.70	27,810
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	103	15	$2,875.00	25%	94%	$3.26	336,612
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	472	15	$4,250.00	5%	94%	$0.84	18,635
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	702	15	$4,250.00	5%	94%	$0.54	42,151
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	50	15	$4,375.00	50%	94%	$12.03	7,665
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	75	15	$4,375.00	50%	94%	$8.07	4,176
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	289	15	$3,875.00	75%	94%	$1.54	1,025,071
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	430	15	$3,875.00	75%	94%	$1.06	2,036,422
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	148	15	$3,000.00	50%	94%	$2.51	312,365
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	220	15	$3,000.00	50%	94%	$1.69	956,156
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	526	15	$13,375.00	25%	94%	$3.35	148,252

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	782	15	$13,375.00	25%	94%	$2.23	59,518
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	1102	15	$14,000.00	25%	94%	$1.67	190,088
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Automated Ventilation VFD Control (Occupancy Sensors / CO2 Sensors)	Demand Controlled Ventilation (CO2 sensors)	Constant Ventilation	Existing	Per Building	1637	15	$14,000.00	25%	94%	$1.09	76,316
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	1260	10	$241.65	1%	95%	-$0.05	906
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	938	10	$241.65	1%	95%	-$0.04	339
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	1106	10	$241.65	1%	95%	-$0.05	10,911
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	1122	10	$241.65	1%	95%	-$0.05	4,221
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	980	10	$2,255.37	2%	95%	$0.31	587
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	730	10	$2,255.37	2%	95%	$0.45	220
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	861	10	$2,255.37	2%	95%	$0.37	7,062
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	873	10	$2,255.37	2%	95%	$0.36	2,732
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	68	10	$80.55	0%	95%	$0.12	92
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	50	10	$80.55	0%	95%	$0.19	35
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	59	10	$80.55	0%	95%	$0.15	1,113
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	60	10	$80.55	0%	95%	$0.15	431
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	556	10	$603.31	2%	95%	$0.10	671
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	414	10	$603.31	2%	95%	$0.17	251

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	488	10	$603.31	2%	95%	$0.13	8,075
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	495	10	$603.31	2%	95%	$0.13	3,123
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	987	10	$631.51	2%	95%	$0.03	730
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	735	10	$631.51	2%	95%	$0.06	273
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	866	10	$631.51	2%	95%	$0.04	8,782
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Clothes Washer - Ozonating	Ozonating Clothes Washer	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	879	10	$631.51	2%	95%	$0.04	3,397
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	4	7	$43.17	95%	80%	$2.35	292
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	4	7	$43.17	95%	80%	$2.35	147
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	4	7	$43.17	95%	80%	$2.35	4,008
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	4	7	$43.17	95%	80%	$2.35	1,528
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	36	7	$402.89	95%	80%	$2.35	962
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	36	7	$402.89	95%	80%	$2.35	484
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	36	7	$402.89	95%	80%	$2.35	13,196
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	36	7	$402.89	95%	80%	$2.35	5,030
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	1	7	$14.39	95%	80%	$2.35	559
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	1	7	$14.39	95%	80%	$2.35	281
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	1	7	$14.39	95%	80%	$2.35	7,666
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43,	2013 Federal Standard Clothes Washer - MEF = 1.6,	New	Per Building	1	7	$14.39	95%	80%	$2.35	2,922

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
						WF = 4.0	WF = 8.5									
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	10	7	$107.77	95%	80%	$2.35	519
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	10	7	$107.77	95%	80%	$2.35	261
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	10	7	$107.77	95%	80%	$2.35	7,120
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	10	7	$107.77	95%	80%	$2.35	2,714
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	10	7	$112.81	95%	80%	$2.35	333
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	10	7	$112.81	95%	80%	$2.35	167
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	Existing	Per Building	10	7	$112.81	95%	80%	$2.35	4,565
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Clothes Washer Commercial	ENERGY STAR Commercial Clothes Washer - MEF = 2.43, WF = 4.0	2013 Federal Standard Clothes Washer - MEF = 1.6, WF = 8.5	New	Per Building	10	7	$112.81	95%	80%	$2.35	1,740
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	188	15	$34,943.57	15%	67%	$25.10	31,758
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	279	15	$34,943.57	15%	67%	$16.97	384,396
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	1284	15	$51,655.72	15%	67%	$5.27	108,201
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	1907	15	$51,655.72	15%	67%	$3.52	244,737
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	685	15	$53,175.00	15%	67%	$10.75	22,159
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	1018	15	$53,175.00	15%	67%	$7.20	12,072
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	786	15	$47,097.85	15%	67%	$8.09	373,717
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	1168	15	$47,097.85	15%	67%	$5.46	742,431
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	403	15	$36,462.85	15%	67%	$12.41	174,588
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	598	15	$36,462.85	15%	67%	$8.35	534,417
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	1431	15	$162,563.57	15%	67%	$15.74	169,298
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	2125	15	$162,563.57	15%	67%	$10.57	67,968

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	2995	15	$170,160.00	15%	67%	$7.86	217,073
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Convert Constant Volume Air System to VAV	Variable Volume Air System	Constant Volume Air System	Existing	Per Building	4449	15	$170,160.00	15%	67%	$5.25	87,150
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	19	10	$3,194.76	75%	94%	$29.03	5,886
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	14	10	$3,194.76	90%	94%	$39.03	2,644
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	16	10	$3,194.76	75%	94%	$33.08	70,850
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	17	10	$3,194.76	90%	94%	$32.60	32,887
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	236	10	$8,889.78	75%	94%	$6.35	3,845
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	176	10	$8,889.78	90%	94%	$8.56	1,727
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	208	10	$8,889.78	75%	94%	$7.25	46,288
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	211	10	$8,889.78	90%	94%	$7.14	21,485
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	417	10	$4,722.69	55%	94%	$1.86	21,711
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	310	10	$4,722.69	55%	94%	$2.52	8,125
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	366	10	$4,722.69	55%	94%	$2.13	261,343
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	371	10	$4,722.69	55%	94%	$2.10	101,090
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	324	10	$4,861.60	55%	80%	$2.48	5,098
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	241	10	$4,861.60	55%	80%	$3.37	1,906
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	284	10	$4,861.60	55%	80%	$2.84	61,340
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	289	10	$4,861.60	55%	80%	$2.80	23,728

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	32	10	$4,305.99	55%	80%	$22.66	7,482
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	24	10	$4,305.99	55%	80%	$30.47	2,801
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	28	10	$4,305.99	55%	80%	$25.83	90,068
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	29	10	$4,305.99	55%	80%	$25.44	34,843
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	22	10	$3,333.67	75%	94%	$25.45	9,053
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	17	10	$3,333.67	90%	94%	$34.22	4,063
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	20	10	$3,333.67	75%	94%	$29.01	108,944
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	20	10	$3,333.67	90%	94%	$28.58	50,571
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	90	10	$972.32	75%	94%	$1.77	10,392
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	67	10	$972.32	90%	94%	$2.41	4,667
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	79	10	$972.32	75%	94%	$2.03	125,094
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	80	10	$972.32	90%	94%	$2.00	58,066
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	184	10	$14,862.60	55%	94%	$13.76	6,865
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	137	10	$14,862.60	55%	94%	$18.52	2,568
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	161	10	$14,862.60	55%	94%	$15.69	82,620
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	164	10	$14,862.60	55%	94%	$15.46	31,958
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	326	10	$15,557.11	55%	94%	$8.08	7,472
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by	Constant Circulation	New	Per Building	243	10	$15,557.11	55%	94%	$10.88	2,796

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
						demand)										
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	286	10	$15,557.11	55%	94%	$9.21	89,938
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	291	10	$15,557.11	55%	94%	$9.08	34,790
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	70	10	$16,807.24	55%	94%	$40.96	1,355
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	52	10	$16,807.24	55%	94%	$55.06	507
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	Existing	Per Building	62	10	$16,807.24	55%	94%	$46.68	16,309
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Demand Controlled Circulating Systems	Demand Controlled Circulating Systems (VFD control by demand)	Constant Circulation	New	Per Building	62	10	$16,807.24	55%	94%	$46.00	6,309
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	135	8	$11,216.93	75%	59%	$15.48	97,664
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	200	8	$11,216.93	75%	59%	$10.49	1,182,102
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	1244	8	$31,212.31	75%	61%	$4.51	2,166
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	1848	8	$31,212.31	75%	61%	$3.03	382,728
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	918	8	$16,581.54	35%	26%	$3.18	67,661
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	1365	8	$16,581.54	35%	26%	$2.12	153,041
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	490	8	$17,069.23	5%	52%	$6.73	4,026
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	729	8	$17,069.23	5%	52%	$4.50	2,193
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	563	8	$15,118.46	45%	28%	$4.99	323,874

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	836	8	$15,118.46	45%	28%	$3.38	643,412
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	288	8	$11,704.62	50%	66%	$7.72	396,074
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	428	8	$11,704.62	50%	66%	$5.19	1,212,392
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	37	8	$3,413.85	5%	100%	$15.24	7,356
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	1024	8	$52,183.07	5%	34%	$9.86	20,112
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	1521	8	$52,183.07	5%	34%	$6.61	8,074
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	2143	8	$54,621.54	5%	34%	$4.92	25,705
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	3184	8	$54,621.54	5%	34%	$3.27	10,320
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	857	8	$59,010.77	5%	93%	$13.47	1,507
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Direct Digital Control System-Installation	DDC Retrofit (Morning Warm-Up Control Logic Included in This Measure)	Pneumatic	Existing	Per Building	1272	8	$59,010.77	5%	93%	$9.03	113,470
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	918	8	$12,580.00	75%	80%	$2.33	236,067
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	1365	8	$12,580.00	75%	80%	$1.54	533,956
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	490	8	$12,950.00	50%	80%	$5.08	54,993
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	729	8	$12,950.00	50%	80%	$3.39	29,960
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	563	8	$11,470.00	50%	80%	$3.71	101,301
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	836	8	$11,470.00	50%	80%	$2.51	201,247
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	37	8	$2,590.00	50%	100%	$10.88	65,640

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	1024	8	$39,590.00	50%	80%	$7.43	420,819
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	1521	8	$39,590.00	50%	80%	$4.97	168,944
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	2143	8	$41,440.00	50%	80%	$3.70	539,577
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	3184	8	$41,440.00	50%	80%	$2.46	216,627
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	857	8	$44,770.00	50%	98%	$10.19	14,144
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Direct Digital Control System-Wireless System	DDC Retrofit - Wireless System	Pneumatic	Existing	Per Building	1272	8	$44,770.00	50%	98%	$6.82	1,065,029
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	3	12	$42.32	95%	95%	$2.29	58
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	3	12	$42.32	95%	95%	$2.29	29
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	3	12	$42.32	95%	95%	$2.29	799
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	3	12	$42.32	95%	95%	$2.29	305
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	4	12	$65.11	95%	95%	$2.29	393
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	4	12	$65.11	95%	95%	$2.29	197
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	4	12	$65.11	95%	95%	$2.29	5,383
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	4	12	$65.11	95%	95%	$2.29	2,052
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	10	12	$145.60	95%	95%	$2.29	313
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	10	12	$145.60	95%	95%	$2.29	157
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes	Standard High Temp Commercial Dishwasher	Existing	Per Building	10	12	$145.60	95%	95%	$2.29	4,292

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
						Extra Chemical Cost) - (ENERGY STAR)										
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	10	12	$145.60	95%	95%	$2.29	1,636
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	0	12	$2.51	95%	95%	$2.30	86
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	0	12	$2.51	95%	95%	$2.30	43
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	0	12	$2.51	95%	95%	$2.30	1,183
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	0	12	$2.51	95%	95%	$2.30	451
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	107	12	$1,624.40	95%	95%	$2.29	15,927
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	107	12	$1,624.40	95%	95%	$2.29	8,009
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	107	12	$1,624.40	95%	95%	$2.29	218,442
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	107	12	$1,624.40	95%	95%	$2.29	83,261
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	15	12	$232.68	95%	95%	$2.29	1,009
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	15	12	$232.68	95%	95%	$2.29	507
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	15	12	$232.68	95%	95%	$2.29	13,834
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	15	12	$232.68	95%	95%	$2.29	5,273
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost)	Standard High Temp Commercial Dishwasher	Existing	Per Building	15	12	$232.68	95%	95%	$2.29	618

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
						- (ENERGY STAR)										
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	15	12	$232.68	95%	95%	$2.29	311
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	Existing	Per Building	15	12	$232.68	95%	95%	$2.29	8,473
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Dishwashing - Commercial - Low Temp	Low-Temp Commercial Dishwasher (Includes Extra Chemical Cost) - (ENERGY STAR)	Standard High Temp Commercial Dishwasher	New	Per Building	15	12	$232.68	95%	95%	$2.29	3,230
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	75	25	$1,250.03	5%	92%	$1.96	1,482
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	56	25	$1,250.03	25%	92%	$2.67	2,753
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	66	25	$1,250.03	5%	92%	$2.25	17,840
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	67	25	$1,250.03	25%	92%	$2.22	34,251
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	946	25	$8,333.50	5%	92%	$1.00	968
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	704	25	$8,333.50	25%	92%	$1.37	1,797
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	830	25	$8,333.50	5%	92%	$1.15	11,648
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	843	25	$8,333.50	25%	92%	$1.13	22,362
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	1666	25	$12,083.58	5%	92%	$0.81	7,524
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	1240	25	$12,083.58	25%	92%	$1.12	14,076
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	1463	25	$12,083.58	5%	92%	$0.93	90,558
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	1484	25	$12,083.58	25%	92%	$0.92	175,145
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	1297	25	$11,458.56	5%	92%	$1.00	2,082
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	965	25	$11,458.56	25%	92%	$1.38	3,890
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	1138	25	$11,458.56	5%	92%	$1.16	25,047
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	1155	25	$11,458.56	25%	92%	$1.14	48,447
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	130	25	$2,083.38	5%	92%	$1.89	3,060
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water	Install (Power-Pipe or GFX) - Heat Recovery	No Heat Recovery System	New	Per Building	96	25	$2,083.38	25%	92%	$2.57	5,727

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
					Heater	Water Heater										
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	114	25	$2,083.38	5%	92%	$2.17	36,836
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	115	25	$2,083.38	25%	92%	$2.14	71,251
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	89	25	$2,291.71	5%	92%	$3.07	2,279
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	67	25	$2,291.71	25%	92%	$4.16	4,230
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	78	25	$2,291.71	5%	92%	$3.51	27,420
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	80	25	$2,291.71	25%	92%	$3.46	52,648
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	359	25	$1,875.04	5%	92%	$0.56	2,470
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	267	25	$1,875.04	25%	92%	$0.78	4,493
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	315	25	$1,875.04	5%	92%	$0.65	29,488
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	320	25	$1,875.04	25%	92%	$0.64	56,644
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	735	25	$7,916.83	5%	92%	$1.24	2,371
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	547	25	$7,916.83	25%	92%	$1.70	4,428
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	645	25	$7,916.83	5%	92%	$1.43	28,517
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	655	25	$7,916.83	25%	92%	$1.41	55,156
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	1305	25	$8,333.50	5%	92%	$0.70	2,585
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	971	25	$8,333.50	25%	92%	$0.97	4,832
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	1146	25	$8,333.50	5%	92%	$0.81	31,103
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	1163	25	$8,333.50	25%	92%	$0.80	60,159
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	280	25	$1,458.36	5%	92%	$0.56	470
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	209	25	$1,458.36	25%	92%	$0.78	879
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	Existing	Per Building	246	25	$1,458.36	5%	92%	$0.65	5,654
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Drainwater Heat Recovery Water Heater	Install (Power-Pipe or GFX) - Heat Recovery Water Heater	No Heat Recovery System	New	Per Building	250	25	$1,458.36	25%	92%	$0.64	10,936

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	102	18	$8,625.00	45%	45%	$10.41	253,108
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	939	18	$16,000.00	45%	45%	$1.90	79,572
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	693	18	$8,500.00	45%	45%	$1.31	162,304
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	370	18	$8,750.00	45%	45%	$2.95	8,036
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	425	18	$7,750.00	45%	45%	$2.17	514,188
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	217	18	$6,750.00	45%	45%	$3.82	359,480
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	19	18	$3,500.00	45%	45%	$21.08	13,855
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	773	18	$35,666.67	45%	45%	$5.84	45,317
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	1618	18	$37,333.33	45%	45%	$2.88	58,107
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Duct Repair And Sealing	Reduction In Duct Losses to 5%	No Repair or Sealing, 15% duct losses	Existing	Per Building	647	18	$22,687.50	45%	45%	$4.42	229,762
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	118	14	$28,078.84	5%	94%	$34.44	8,372
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	65	14	$28,078.84	5%	94%	$62.86	1,955
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	175	14	$28,078.84	5%	94%	$23.14	99,552
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	98	14	$28,078.84	5%	94%	$41.41	24,261
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	1090	14	$78,132.42	5%	94%	$10.28	180
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	229	14	$78,132.42	5%	94%	$49.44	15
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	1620	14	$78,132.42	5%	94%	$6.89	31,297
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	347	14	$78,132.42	5%	94%	$32.56	2,793
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	805	14	$41,507.85	5%	94%	$7.37	28,729
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	776	14	$41,507.85	5%	94%	$7.65	11,501
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	1196	14	$41,507.85	5%	94%	$4.92	63,836
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	1177	14	$41,507.85	5%	94%	$5.01	26,682
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	430	14	$42,728.68	5%	94%	$14.31	5,906
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	305	14	$42,728.68	5%	94%	$20.23	1,741
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	639	14	$42,728.68	5%	94%	$9.59	3,161

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	462	14	$42,728.68	5%	94%	$13.30	972
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	493	14	$37,845.39	5%	94%	$11.02	103,626
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	239	14	$37,845.39	5%	94%	$22.88	21,201
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	733	14	$37,845.39	5%	94%	$7.38	202,239
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	362	14	$37,845.39	5%	94%	$15.05	43,176
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	252	14	$29,299.66	5%	94%	$16.73	47,018
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	126	14	$29,299.66	5%	94%	$33.57	10,005
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	375	14	$29,299.66	5%	94%	$11.22	141,390
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	191	14	$29,299.66	5%	94%	$22.10	31,396
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	33	14	$8,545.73	5%	94%	$37.88	5,449
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	24	14	$8,545.73	5%	94%	$50.83	1,707
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	897	14	$130,627.65	5%	94%	$21.01	45,193
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	750	14	$130,627.65	5%	94%	$25.17	15,873
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	1333	14	$130,627.65	5%	94%	$14.11	17,823
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	1137	14	$130,627.65	5%	94%	$16.55	6,535
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	1878	14	$136,731.75	5%	94%	$10.45	57,947
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	1569	14	$136,731.75	5%	94%	$12.53	20,352
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	2791	14	$136,731.75	5%	94%	$7.00	22,854
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	2380	14	$136,731.75	5%	94%	$8.22	8,379
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	751	14	$147,719.12	5%	94%	$28.43	1,221
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	408	14	$147,719.12	5%	94%	$52.46	272
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	Existing	Per Building	1115	14	$147,719.12	5%	94%	$19.10	90,370
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Exhaust Air to Ventilation Air Heat Recovery	Exhaust Air Heat Recovery	No Heat Recovery	New	Per Building	618	14	$147,719.12	5%	94%	$34.56	20,983

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	3	10	$439.33	64%	85%	$17.64	6
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	3	10	$439.33	64%	85%	$17.64	3
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	3	10	$439.33	64%	85%	$18.15	755
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	3	10	$439.33	64%	85%	$18.15	315
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	1	10	$88.86	62%	85%	$17.54	271
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	1	10	$88.86	62%	85%	$17.54	113
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	1	10	$88.86	62%	85%	$17.90	406
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	1	10	$88.86	62%	85%	$17.90	172
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	1	10	$106.96	58%	85%	$21.77	118
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	1	10	$106.96	58%	85%	$21.77	49
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	1	10	$106.96	58%	85%	$21.85	42
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	1	10	$106.96	58%	85%	$21.85	18
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	0	10	$64.17	100%	85%	$20.56	1,662
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	0	10	$64.17	100%	85%	$20.56	707

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	0	10	$64.17	100%	85%	$20.94	3,363
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	0	10	$64.17	100%	85%	$20.94	1,464
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	12	10	$1,550.00	100%	85%	$17.85	35,982
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	12	10	$1,550.00	100%	85%	$17.85	15,111
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	0	10	$36.20	73%	85%	$19.09	184
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	0	10	$36.20	73%	85%	$19.09	77
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	0	10	$36.20	73%	85%	$19.55	49
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	0	10	$36.20	73%	85%	$19.55	21
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	1	10	$69.11	73%	85%	$21.92	216
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	1	10	$69.11	73%	85%	$21.92	91
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	Existing	Per Building	1	10	$69.11	73%	85%	$21.92	57
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Exhaust Hood Makeup Air	Provide Makeup Air Directly at Exhaust Hood Instead of Pulling Conditioned Air	Hood Pulls Conditioned Air (No Make-up Air)	New	Per Building	1	10	$69.11	73%	85%	$21.92	25
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	Existing	Per Building	71	10	$113.37	85%	55%	$0.19	9,945
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	Per Building	71	10	$113.37	85%	55%	$0.19	3,180
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	Existing	Per Building	7	10	$22.93	85%	55%	$0.45	6,884
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	Per Building	7	10	$22.93	85%	55%	$0.45	2,202

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	Existing	Per Building	16	10	$27.61	85%	55%	$0.21	6,657
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	Per Building	16	10	$27.61	85%	55%	$0.21	2,129
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	Existing	Per Building	6	10	$27.61	85%	55%	$0.77	24,494
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	Per Building	6	10	$27.61	85%	55%	$0.77	7,832
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	Existing	Per Building	65	10	$400.00	85%	55%	$0.97	117,219
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	Per Building	65	10	$400.00	85%	55%	$0.97	37,481
Gas	Energy Efficiency	School	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	Existing	Per Building	13	10	$9.34	85%	55%	$0.04	5,075
Gas	Energy Efficiency	School	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	Per Building	13	10	$9.34	85%	55%	$0.04	1,623
Gas	Energy Efficiency	University	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	Existing	Per Building	32	10	$17.84	85%	55%	$0.01	7,295
Gas	Energy Efficiency	University	Cooking	Retrofit	High Efficiency Convection Oven	Convection Oven	Standard Oven	New	Per Building	32	10	$17.84	85%	55%	$0.01	2,333
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	79	13	$782.39	5%	39%	$1.11	2,285
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	117	13	$782.39	5%	39%	$0.74	27,166
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	727	13	$1,546.21	5%	39%	$0.10	49
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	1080	13	$1,546.21	5%	39%	$0.04	8,539
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	537	13	$1,070.63	5%	39%	$0.10	7,839
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	797	13	$1,070.63	5%	39%	$0.04	17,420
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	287	13	$2,269.19	5%	39%	$1.07	1,611
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	426	13	$2,269.19	5%	39%	$0.69	862
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	329	13	$1,223.44	10%	39%	$0.39	56,556
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	489	13	$1,223.44	10%	39%	$0.24	110,377
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	168	13	$417.73	5%	39%	$0.20	12,827
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	250	13	$417.73	5%	39%	$0.11	38,577
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	22	13	$347.05	5%	39%	$1.39	1,417
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	598	13	$3,427.28	5%	39%	$0.72	12,332
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	889	13	$3,427.28	5%	39%	$0.45	4,864

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	1252	13	$3,587.43	5%	39%	$0.32	15,812
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	1860	13	$3,587.43	5%	39%	$0.18	6,237
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	501	13	$1,036.14	5%	39%	$0.20	333
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Infiltration Reduction	Install Caulking And Weatherstripping (ACH 0.65)	Infiltration Conditions (ACH 1.0)	Existing	Per Building	744	13	$1,036.14	5%	39%	$0.10	24,661
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	1	45	$2,353.06	25%	83%	$259.57	312
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	1	45	$2,353.06	75%	83%	$473.23	219
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	1	45	$2,353.06	25%	83%	$174.68	3,711
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	1	45	$2,353.06	75%	83%	$312.05	2,718
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	9	45	$6,779.13	25%	70%	$79.62	6
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	2	45	$6,779.13	75%	70%	$379.98	1
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	14	45	$6,779.13	25%	70%	$53.56	998
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	3	45	$6,779.13	75%	70%	$250.54	268
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	11	45	$2,568.25	25%	70%	$26.23	1,423
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	10	45	$2,568.25	75%	70%	$27.24	1,712
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	16	45	$2,568.25	25%	70%	$17.62	3,161
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	16	45	$2,568.25	75%	70%	$17.92	3,972
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	4	45	$1,594.53	25%	70%	$40.31	222
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	3	45	$1,594.53	75%	70%	$56.92	196
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	6	45	$1,594.53	25%	70%	$27.10	119
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	5	45	$1,594.53	75%	70%	$37.50	110
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	6	45	$2,130.96	25%	50%	$37.26	3,493
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	3	45	$2,130.96	75%	50%	$77.08	2,152
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	9	45	$2,130.96	25%	50%	$25.04	6,817
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	5	45	$2,130.96	75%	50%	$50.79	4,383
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	4	45	$2,457.09	25%	70%	$70.07	2,667
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	2	45	$2,457.09	75%	70%	$140.28	1,705
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	6	45	$2,457.09	25%	70%	$47.13	8,020
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	3	45	$2,457.09	75%	70%	$92.47	5,352

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	0	45	$691.25	25%	83%	$154.90	344
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	0	45	$691.25	75%	83%	$207.81	318
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	77	45	$11,662.86	25%	70%	$16.72	14,275
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	64	45	$11,662.86	75%	70%	$20.04	15,071
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	114	45	$11,662.86	25%	70%	$11.22	5,630
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	97	45	$11,662.86	75%	70%	$13.17	6,205
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	161	45	$5,441.38	25%	70%	$3.64	18,304
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	134	45	$5,441.38	75%	70%	$4.38	19,324
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	239	45	$5,441.38	25%	70%	$2.42	7,219
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	204	45	$5,441.38	75%	70%	$2.85	7,955
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	8	45	$13,313.08	25%	70%	$189.52	47
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	4	45	$13,313.08	75%	70%	$349.20	31
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	Existing	Per Building	12	45	$13,313.08	25%	70%	$127.53	3,457
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-38 c.i.	R-30 c.i. (WA State Code)	New	Per Building	6	45	$13,313.08	75%	70%	$230.24	2,413
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	17	45	$3,235.45	25%	98%	$21.47	6,094
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	9	45	$3,235.45	75%	98%	$39.23	4,275
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	25	45	$3,235.45	25%	98%	$14.42	72,458
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	14	45	$3,235.45	75%	98%	$25.84	53,050
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	149	45	$9,321.30	25%	85%	$6.82	110
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	31	45	$9,321.30	75%	85%	$32.92	28
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	222	45	$9,321.30	25%	85%	$4.55	19,172
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	47	45	$9,321.30	75%	85%	$21.67	5,138
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	112	45	$3,531.33	25%	85%	$3.39	17,854
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	108	45	$3,531.33	75%	85%	$3.53	21,469
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	166	45	$3,531.33	25%	85%	$2.25	39,673
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	163	45	$3,531.33	75%	85%	$2.29	49,808
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	51	45	$2,192.49	25%	85%	$4.62	3,159
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	36	45	$2,192.49	75%	85%	$6.57	2,797
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	76	45	$2,192.49	25%	85%	$3.08	1,691

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	55	45	$2,192.49	75%	85%	$4.29	1,562
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	45	45	$2,930.08	25%	65%	$7.17	32,065
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	22	45	$2,930.08	75%	65%	$14.92	19,747
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	66	45	$2,930.08	25%	65%	$4.79	62,579
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	33	45	$2,930.08	75%	65%	$9.80	40,216
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	29	45	$3,378.50	25%	85%	$12.90	24,007
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	14	45	$3,378.50	75%	85%	$25.92	15,338
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	43	45	$3,378.50	25%	85%	$8.65	72,199
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	22	45	$3,378.50	75%	85%	$17.05	48,143
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	4	45	$950.47	25%	98%	$23.48	3,669
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	3	45	$950.47	75%	98%	$31.54	3,393
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	107	45	$16,036.42	25%	85%	$16.55	24,026
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	89	45	$16,036.42	75%	85%	$19.83	25,250
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	159	45	$16,036.42	25%	85%	$11.11	9,476
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	135	45	$16,036.42	75%	85%	$13.04	10,395
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	223	45	$7,481.89	25%	85%	$3.60	30,806
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	187	45	$7,481.89	75%	85%	$4.33	32,375
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	332	45	$7,481.89	25%	85%	$2.39	12,150
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	283	45	$7,481.89	75%	85%	$2.82	13,329
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	71	45	$18,305.46	25%	85%	$28.59	515
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	38	45	$18,305.46	75%	85%	$52.76	344
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	Existing	Per Building	105	45	$18,305.46	25%	85%	$19.21	38,126
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-49 c.i.	R-38 c.i.	New	Per Building	58	45	$18,305.46	75%	85%	$34.75	26,594
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	186	45	$17,883.24	25%	85%	$10.52	58,939
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	277	45	$17,883.24	25%	85%	$7.05	700,830
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	1672	45	$51,521.36	25%	10%	$3.30	145
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	2484	45	$51,521.36	25%	10%	$2.19	25,173
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	918	45	$19,518.70	25%	13%	$2.24	22,339
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	1364	45	$19,518.70	25%	13%	$1.47	49,639

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	422	45	$12,118.44	25%	25%	$3.07	7,605
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	627	45	$12,118.44	25%	25%	$2.03	4,071
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	367	45	$16,195.31	25%	4%	$4.78	16,179
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	545	45	$16,195.31	25%	4%	$3.18	31,575
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	237	45	$18,673.87	25%	30%	$8.64	69,373
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	351	45	$18,673.87	25%	30%	$5.78	208,631
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	37	45	$5,253.51	25%	85%	$15.73	26,018
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	3680	45	$88,637.73	25%	15%	$2.56	145,660
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	5467	45	$88,637.73	25%	15%	$1.69	57,448
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	7703	45	$41,354.45	25%	13%	$0.49	161,864
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	11444	45	$41,354.45	25%	13%	$0.29	63,841
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	793	45	$101,179.32	25%	10%	$14.04	678
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Ceiling	R-30 c.i. (WA State Code)	Average Existing Conditions	Existing	Per Building	1178	45	$101,179.32	25%	10%	$9.42	50,128
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	49	20	$2,834.63	75%	15%	$6.60	62,451
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	454	20	$7,887.68	75%	15%	$1.85	20,570
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	335	20	$4,190.34	75%	15%	$1.28	41,962
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	179	20	$4,313.57	75%	15%	$2.88	2,071
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	205	20	$3,820.59	75%	15%	$2.12	133,590
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	105	20	$2,957.88	75%	15%	$3.30	92,531
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	9	20	$862.71	75%	15%	$8.87	3,308
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	373	20	$13,187.21	75%	15%	$4.25	11,496
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	781	20	$13,803.44	75%	15%	$2.08	14,787
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Duct	R-7 (WA State Code)	No Insulation	Existing	Per Building	312	20	$14,912.65	75%	15%	$5.81	59,590
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	179	45	$17,883.24	35%	90%	$10.97	79,708
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	266	45	$17,883.24	35%	90%	$7.35	943,303
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	1675	45	$51,521.36	35%	45%	$3.30	910
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	2489	45	$51,521.36	35%	45%	$2.18	157,249
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	487	45	$19,518.70	35%	35%	$4.34	44,389
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	723	45	$19,518.70	35%	35%	$2.88	98,170

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	678	45	$12,118.44	35%	45%	$1.87	30,532
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	1008	45	$12,118.44	35%	45%	$1.22	16,264
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	644	45	$16,195.31	35%	15%	$2.68	148,921
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	957	45	$16,195.31	35%	15%	$1.77	289,266
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	557	45	$18,673.87	35%	50%	$3.61	377,062
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	827	45	$18,673.87	35%	50%	$2.39	1,128,607
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	49	45	$5,253.51	35%	90%	$11.80	49,342
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	1392	45	$88,637.73	35%	35%	$6.95	175,857
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	2068	45	$88,637.73	35%	35%	$4.64	69,031
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	2104	45	$41,354.45	35%	35%	$2.07	163,305
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	3126	45	$41,354.45	35%	35%	$1.36	64,105
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	1698	45	$101,179.32	35%	45%	$6.50	9,110
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-30 (WA State Code)	Average Existing Conditions	Existing	Per Building	2523	45	$101,179.32	35%	45%	$4.34	670,715
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	33	45	$2,353.06	35%	90%	$7.72	13,773
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	18	45	$2,353.06	35%	90%	$14.17	3,616
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	49	45	$2,353.06	35%	90%	$5.16	162,995
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	28	45	$2,353.06	35%	90%	$9.30	44,866
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	312	45	$6,779.13	35%	45%	$2.30	163
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	65	45	$6,779.13	35%	45%	$11.38	14
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	463	45	$6,779.13	35%	45%	$1.51	28,208
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	99	45	$6,779.13	35%	45%	$7.47	2,619
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	203	45	$2,568.25	35%	35%	$1.29	18,326
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	196	45	$2,568.25	35%	35%	$1.34	7,403
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	302	45	$2,568.25	35%	35%	$0.83	40,530
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	297	45	$2,568.25	35%	35%	$0.85	17,175
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	87	45	$1,594.53	35%	45%	$1.92	3,765
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	62	45	$1,594.53	35%	45%	$2.76	1,156
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	129	45	$1,594.53	35%	45%	$1.26	2,006
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	93	45	$1,594.53	35%	45%	$1.78	646

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	120	45	$2,130.96	35%	15%	$1.86	27,435
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	58	45	$2,130.96	35%	15%	$3.96	5,672
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	178	45	$2,130.96	35%	15%	$1.22	53,290
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	88	45	$2,130.96	35%	15%	$2.57	11,550
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	71	45	$2,457.09	35%	50%	$3.71	45,502
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	36	45	$2,457.09	35%	50%	$7.53	10,320
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	106	45	$2,457.09	35%	50%	$2.46	136,196
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	54	45	$2,457.09	35%	50%	$4.93	32,391
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	9	45	$691.25	35%	90%	$8.31	8,534
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	7	45	$691.25	35%	90%	$11.18	2,920
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	259	45	$11,662.86	35%	35%	$4.88	31,801
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	216	45	$11,662.86	35%	35%	$5.86	11,649
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	385	45	$11,662.86	35%	35%	$3.25	12,483
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	328	45	$11,662.86	35%	35%	$3.83	4,796
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	392	45	$5,441.38	35%	35%	$1.43	29,772
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	327	45	$5,441.38	35%	35%	$1.73	10,783
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	582	45	$5,441.38	35%	35%	$0.93	11,687
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	496	45	$5,441.38	35%	35%	$1.11	4,439
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	218	45	$13,313.08	35%	45%	$6.68	1,105
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	118	45	$13,313.08	35%	45%	$12.39	259
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	Existing	Per Building	323	45	$13,313.08	35%	45%	$4.46	81,323
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Floor (non-slab)	R-38	R-30 (WA State Code)	New	Per Building	179	45	$13,313.08	35%	45%	$8.13	20,029
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	343	45	$9,537.34	10%	35%	$2.97	15,563
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	510	45	$9,537.34	10%	35%	$1.96	184,182
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	3259	45	$24,043.11	10%	35%	$0.71	377
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	4957	45	$24,043.11	10%	35%	$0.43	66,619
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	3787	45	$9,882.27	10%	35%	$0.18	97,154
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	3575	45	$9,882.27	10%	35%	$0.20	136,525
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	1315	45	$15,529.13	10%	35%	$1.20	12,600

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	2348	45	$15,529.13	10%	35%	$0.62	8,069
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	1446	45	$14,504.82	10%	35%	$1.00	220,193
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	3447	45	$14,504.82	10%	35%	$0.36	686,489
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	735	45	$7,572.78	10%	35%	$1.03	93,084
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	1451	45	$7,572.78	10%	35%	$0.47	370,106
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	100	45	$3,976.43	10%	35%	$4.31	10,258
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	2266	45	$17,892.57	10%	35%	$0.77	79,033
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	3366	45	$17,892.57	10%	35%	$0.48	31,024
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	4744	45	$18,728.67	10%	35%	$0.33	102,638
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	7047	45	$18,728.67	10%	35%	$0.18	40,290
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	2200	45	$39,344.52	10%	35%	$1.87	2,466
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Insulation - Wall	R-16	Average Existing Conditions	Existing	Per Building	5101	45	$39,344.52	10%	35%	$0.74	283,324
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	65	30	$1,725.00	10%	95%	$2.58	31,506
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	231	30	$4,800.00	10%	95%	$1.57	3,658
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	784	30	$2,550.00	10%	95%	$0.23	35,025
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	308	30	$2,625.00	10%	95%	$0.89	1,279
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	241	30	$2,325.00	10%	95%	$0.97	57,236
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	128	30	$1,800.00	10%	95%	$1.47	41,179
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	16	30	$525.00	10%	95%	$2.32	2,077
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	758	30	$8,025.00	10%	95%	$1.12	8,540
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	1587	30	$8,400.00	10%	95%	$0.51	10,966
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Leak Proof Duct Fittings	Quick connect fittings that do not require mastic or drawbands	Standard Duct Fittings	New	Per Building	412	30	$9,075.00	10%	95%	$2.47	27,609
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	5	9	$3.89	95%	25%	$0.06	529

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	4	9	$3.89	95%	25%	$0.08	6,365
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	63	9	$10.82	95%	25%	-$0.05	345
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	55	9	$10.82	95%	25%	-$0.05	4,158
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	111	9	$14.37	95%	25%	-$0.06	2,663
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	98	9	$14.37	95%	25%	-$0.06	32,062
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	86	9	$59.15	95%	25%	$0.04	739
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	76	9	$59.15	95%	25%	$0.06	8,893
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	9	9	$5.24	95%	25%	$0.03	1,077
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	8	9	$5.24	95%	25%	$0.04	12,964
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	6	9	$4.06	95%	25%	$0.04	815
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	5	9	$4.06	95%	25%	$0.06	9,815
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	24	9	$3.38	95%	25%	-$0.06	934
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	21	9	$3.38	95%	25%	-$0.05	11,238
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	49	9	$18.08	95%	25%	-$0.02	845
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	43	9	$18.08	95%	25%	-$0.01	10,169
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	87	9	$18.93	95%	25%	-$0.04	919
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	76	9	$18.93	95%	25%	-$0.04	11,060
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	19	9	$4.09	95%	25%	-$0.04	166
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	2.2 GPM (Federal Code)	3.0 GPM	Existing	Per Building	16	9	$4.09	95%	25%	-$0.04	1,998
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	29	4	$195.00	95%	74%	$2.11	466
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	29	4	$195.00	95%	74%	$2.11	234
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	29	4	$195.00	95%	74%	$2.11	6,394
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	29	4	$195.00	95%	74%	$2.11	2,437
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	6	4	$39.00	95%	83%	$2.11	459
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	6	4	$39.00	95%	83%	$2.11	231
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	6	4	$39.00	95%	83%	$2.11	6,295
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	6	4	$39.00	95%	83%	$2.11	2,401
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	29	4	$195.00	95%	93%	$2.11	909
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	29	4	$195.00	95%	93%	$2.11	457

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	29	4	$195.00	95%	93%	$2.11	12,472
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	29	4	$195.00	95%	93%	$2.11	4,754
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	19	4	$130.00	95%	93%	$2.11	9,706
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	19	4	$130.00	95%	93%	$2.11	4,881
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	19	4	$130.00	95%	93%	$2.11	133,116
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	19	4	$130.00	95%	93%	$2.11	50,740
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	36	4	$247.00	95%	46%	$2.11	2,628
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	36	4	$247.00	95%	46%	$2.11	1,321
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	36	4	$247.00	95%	46%	$2.11	36,037
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	36	4	$247.00	95%	46%	$2.11	13,736
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	35	4	$234.00	95%	65%	$2.11	1,541
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	35	4	$234.00	95%	65%	$2.11	775
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	35	4	$234.00	95%	65%	$2.11	21,132
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	35	4	$234.00	95%	65%	$2.11	8,055
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	35	4	$234.00	95%	65%	$2.11	944
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	35	4	$234.00	95%	65%	$2.11	475
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	Existing	Per Building	35	4	$234.00	95%	65%	$2.11	12,942
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Pre-Rinse Spray Valves	0.6 GPM	1.6 GPM (Federal Standard)	New	Per Building	35	4	$234.00	95%	65%	$2.11	4,934
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	5	10	$51.48	95%	35%	$1.61	175
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	6	10	$51.48	95%	35%	$1.32	2,897
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	149	10	$1,059.80	95%	35%	$1.14	1,781
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	180	10	$1,059.80	95%	35%	$0.93	29,512
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	1	10	$11.74	95%	35%	$2.18	155
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	1	10	$11.74	95%	35%	$1.79	2,572
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	1	10	$9.08	95%	35%	$2.17	132
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	1	10	$9.08	95%	35%	$1.79	2,186
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	24	10	$289.28	95%	35%	$2.00	575
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	29	10	$289.28	95%	35%	$1.64	9,527
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	25	10	$302.80	95%	35%	$2.00	369

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	2.5 GPM (Federal Code)	3.0 GPM	Existing	Per Building	30	10	$302.80	95%	35%	$1.64	6,108
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	4	12	$25.44	75%	90%	$0.98	1,074
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	3	12	$25.44	75%	90%	$1.13	12,925
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	47	12	$101.76	75%	90%	$0.26	698
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	42	12	$101.76	75%	90%	$0.30	8,396
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	83	12	$147.55	75%	70%	$0.20	4,237
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	73	12	$147.55	75%	70%	$0.23	50,985
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	65	12	$139.92	75%	90%	$0.26	1,491
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	57	12	$139.92	75%	90%	$0.30	17,865
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	6	12	$25.44	75%	30%	$0.53	739
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	6	12	$25.44	75%	30%	$0.62	8,891
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	4	12	$27.99	75%	90%	$0.90	1,585
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	4	12	$27.99	75%	90%	$1.04	18,954
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	18	12	$25.44	75%	90%	$0.14	1,772
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	16	12	$25.44	75%	90%	$0.17	21,117
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	37	12	$96.67	75%	70%	$0.33	1,325
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	32	12	$96.67	75%	70%	$0.39	15,909
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	65	12	$101.76	75%	70%	$0.16	1,450
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	57	12	$101.76	75%	70%	$0.20	17,428
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	14	12	$25.44	75%	90%	$0.20	340
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Pipe Insulation - Hot Water (DWH)	1.0" of Insulation, assuming R-4 (WA State Code)	No Insulation	Existing	Per Building	12	12	$25.44	75%	90%	$0.24	4,097
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	39	10	$351.92	95%	26%	$0.56	12,272
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	22	10	$351.92	95%	13%	$1.91	1,352

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	58	10	$351.92	95%	26%	$0.45	145,231
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	33	10	$351.92	95%	13%	$1.32	16,616
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	363	10	$339.91	95%	31%	-$0.28	342
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	76	10	$339.91	95%	15%	-$0.66	13
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	540	10	$339.91	95%	31%	-$0.20	59,164
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	116	10	$339.91	95%	15%	-$0.37	2,285
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	268	10	$476.65	95%	24%	-$0.07	43,192
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	259	10	$476.65	95%	12%	$0.13	7,392
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	399	10	$476.65	95%	24%	-$0.07	96,405
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	392	10	$476.65	95%	12%	$0.05	16,987
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	143	10	$790.29	95%	31%	$0.81	11,368
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	102	10	$790.29	95%	15%	$1.21	1,466
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	213	10	$790.29	95%	31%	$0.51	6,036
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	154	10	$790.29	95%	15%	$0.76	811
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	164	10	$523.76	95%	26%	$0.24	172,480
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	80	10	$523.76	95%	13%	$0.87	14,964
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	244	10	$523.76	95%	26%	$0.17	331,859
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	121	10	$523.76	95%	13%	$0.57	30,185
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	84	10	$351.68	95%	28%	$0.42	80,981
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	42	10	$351.68	95%	14%	$1.15	7,707
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	125	10	$351.68	95%	28%	$0.28	241,154
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	64	10	$351.68	95%	14%	$0.75	23,960
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	11	10	$364.60	95%	25%	$2.89	7,606

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	8	10	$364.60	95%	13%	$6.21	1,083
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	299	10	$330.32	95%	21%	-$0.01	57,727
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	250	10	$330.32	95%	10%	$0.07	8,855
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	444	10	$330.32	95%	21%	-$0.03	22,660
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	379	10	$330.32	95%	10%	$0.01	3,611
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	626	10	$741.08	95%	21%	$0.09	74,969
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	523	10	$741.08	95%	10%	$0.13	11,371
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	930	10	$741.08	95%	21%	$0.03	29,429
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	793	10	$741.08	95%	10%	$0.05	4,637
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	250	10	$327.24	95%	24%	$0.10	1,777
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	136	10	$327.24	95%	12%	$0.28	175
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	Existing	Per Building	372	10	$327.24	95%	24%	$0.03	129,650
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Programmable Thermostat - Web Enabled	Programmable Thermostat - Web Enabled	Programmable Thermostat	New	Per Building	206	10	$327.24	95%	12%	$0.15	13,391
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	160	30	$3,566.04	10%	95%	$2.51	9,377
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	243	30	$3,566.04	10%	95%	$1.62	115,245
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	841	30	$9,922.89	10%	95%	$1.28	110
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	1275	30	$9,922.89	10%	95%	$0.81	19,829
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	192	30	$5,271.54	10%	95%	$3.12	5,587
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	292	30	$5,271.54	10%	95%	$2.02	12,838
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	105	30	$5,426.58	10%	95%	$5.98	1,172
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	159	30	$5,426.58	10%	95%	$3.91	649
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	839	30	$4,806.40	10%	95%	$0.56	147,275
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	1273	30	$4,806.40	10%	95%	$0.33	297,079
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	42	30	$3,721.09	10%	95%	$10.30	6,516
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	64	30	$3,721.09	10%	95%	$6.76	20,256
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	134	30	$1,085.31	10%	95%	$0.85	16,829

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	128	30	$16,589.84	10%	95%	$15.19	5,274
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	194	30	$16,589.84	10%	95%	$9.98	2,151
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	323	30	$17,365.07	10%	95%	$6.23	8,173
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	489	30	$17,365.07	10%	95%	$4.07	3,333
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	43	30	$18,760.47	10%	95%	$51.62	56
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	RE - Thermal Wall	Trombe wall	Conventional Wall Construction	New	Per Building	65	30	$18,760.47	10%	95%	$34.00	4,273
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	118	7	$3,105.00	90%	80%	$4.72	106,946
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	175	7	$3,105.00	90%	80%	$3.25	1,265,658
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	1090	7	$8,640.00	90%	80%	$1.27	2,514
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	1620	7	$8,640.00	90%	80%	$0.85	434,334
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	805	7	$4,590.00	90%	80%	$0.86	409,702
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	1196	7	$4,590.00	90%	80%	$0.56	914,463
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	430	7	$4,725.00	90%	80%	$2.24	82,170
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	639	7	$4,725.00	90%	80%	$1.48	43,627
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	493	7	$4,185.00	90%	80%	$1.53	1,503,126
Gas	Energy Efficiency	Office	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	733	7	$4,185.00	90%	80%	$1.04	2,892,083
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	252	7	$3,240.00	90%	80%	$2.48	638,834
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	375	7	$3,240.00	90%	80%	$1.67	1,902,384
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	33	7	$945.00	90%	80%	$3.41	67,070
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	897	7	$14,445.00	90%	80%	$3.28	629,023
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	1333	7	$14,445.00	90%	80%	$2.18	246,916
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	1878	7	$15,120.00	90%	80%	$1.63	816,890
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	2791	7	$15,120.00	90%	80%	$1.06	320,668
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	751	7	$16,335.00	90%	80%	$4.58	16,851

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Commissioning of Existing Buildings	Existing Building Commissioning (Recommissioning)	Average Existing Conditions	Existing	Per Building	1115	7	$16,335.00	90%	80%	$3.05	1,229,807
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	Per Building	76	9	$147.03	5%	62%	$0.27	698
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	Per Building	76	9	$147.03	5%	62%	$0.27	234
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	Per Building	15	9	$29.74	5%	62%	$0.27	954
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	Per Building	15	9	$29.74	5%	62%	$0.27	320
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	Per Building	18	9	$35.79	3%	62%	$0.27	250
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	Per Building	18	9	$35.79	3%	62%	$0.27	84
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	Per Building	11	9	$21.48	5%	62%	$0.27	3,222
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	Per Building	11	9	$21.48	5%	62%	$0.27	1,081
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	Per Building	267	9	$518.75	20%	62%	$0.27	127,546
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	Per Building	267	9	$518.75	20%	62%	$0.27	42,786
Gas	Energy Efficiency	School	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	Per Building	6	9	$12.11	5%	62%	$0.27	155
Gas	Energy Efficiency	School	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	Per Building	6	9	$12.11	5%	62%	$0.27	52
Gas	Energy Efficiency	University	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	Existing	Per Building	12	9	$23.13	5%	62%	$0.27	182
Gas	Energy Efficiency	University	Cooking	Retrofit	Steam Cooker	ENERGY STAR Steam Cooker	Non ENERGY STAR Steam Cooker	New	Per Building	12	9	$23.13	5%	62%	$0.27	61
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	9	9	$451.95	95%	95%	$8.71	3,767
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	7	9	$451.95	95%	95%	$11.73	1,410
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	8	9	$451.95	95%	95%	$9.93	45,349
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	8	9	$451.95	95%	95%	$9.79	17,542
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	118	9	$1,257.60	95%	95%	$1.86	2,461
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	88	9	$1,257.60	95%	95%	$2.53	921
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	104	9	$1,257.60	95%	95%	$2.13	29,628
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	105	9	$1,257.60	95%	95%	$2.10	11,460
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	208	9	$1,670.25	95%	90%	$1.38	17,978
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	155	9	$1,670.25	95%	90%	$1.89	6,729
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	183	9	$1,670.25	95%	90%	$1.59	216,420

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	186	9	$1,670.25	95%	90%	$1.56	83,713
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	162	9	$6,877.50	95%	85%	$7.67	4,710
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	121	9	$6,877.50	95%	85%	$10.33	1,763
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	142	9	$6,877.50	95%	85%	$8.75	56,695
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	144	9	$6,877.50	95%	85%	$8.62	21,930
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	16	9	$609.15	95%	85%	$6.79	6,866
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	12	9	$609.15	95%	85%	$9.14	2,570
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	14	9	$609.15	95%	85%	$7.74	82,648
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	14	9	$609.15	95%	85%	$7.63	31,973
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	11	9	$471.60	95%	95%	$7.63	5,809
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	8	9	$471.60	95%	95%	$10.28	2,174
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	10	9	$471.60	95%	95%	$8.70	69,930
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	10	9	$471.60	95%	95%	$8.57	27,050
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	45	9	$393.00	95%	75%	$1.52	5,251
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	33	9	$393.00	95%	75%	$2.07	1,965
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	39	9	$393.00	95%	75%	$1.74	63,213
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	40	9	$393.00	95%	75%	$1.71	24,451
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	92	9	$2,102.55	95%	75%	$4.10	4,752
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	68	9	$2,102.55	95%	75%	$5.53	1,778
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	81	9	$2,102.55	95%	75%	$4.68	57,201
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	82	9	$2,102.55	95%	75%	$4.61	22,125
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	163	9	$2,200.80	95%	75%	$2.38	5,168
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	121	9	$2,200.80	95%	75%	$3.23	1,934

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	143	9	$2,200.80	95%	75%	$2.73	62,211
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	145	9	$2,200.80	95%	75%	$2.68	24,064
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	35	9	$475.53	95%	95%	$2.40	1,183
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	26	9	$475.53	95%	95%	$3.25	443
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	Existing	Per Building	31	9	$475.53	95%	95%	$2.74	14,235
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Ultrasonic Faucet Control	Install Ultrasonic Motion Faucet Control	No Faucet Control	New	Per Building	31	9	$475.53	95%	95%	$2.70	5,506
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	Per Building	539	10	$29,120.00	75%	55%	$9.16	4,694
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	Per Building	473	10	$29,120.00	75%	55%	$10.45	56,467
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	Per Building	1	10	$107.09	75%	100%	$35.89	194
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Water Cooled Refrigeration with Heat Recovery	Heat Recovery from refrigeration system. Applied to Water Heating Electric End use	No heat recovery	Existing	Per Building	0	10	$107.09	75%	100%	$40.90	2,325
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	Per Building	57	45	$8,149.30	15%	60%	$15.86	4,423
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	Per Building	47	45	$8,149.30	80%	60%	$19.00	9,842
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	Per Building	84	45	$8,149.30	15%	60%	$10.64	1,736
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	Per Building	72	45	$8,149.30	80%	60%	$12.49	4,013
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	Per Building	118	45	$8,530.11	15%	60%	$7.87	5,744
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	Per Building	99	45	$8,530.11	80%	60%	$9.44	12,632
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	Existing	Per Building	176	45	$8,530.11	15%	60%	$5.26	2,255
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.32	U-0.40 (WA State Code)	New	Per Building	150	45	$8,530.11	80%	60%	$6.19	5,151
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	12	45	$16,787.65	15%	80%	$145.28	1,659
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	18	45	$16,787.65	15%	80%	$98.51	19,631
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	54	45	$33,177.25	15%	85%	$62.55	20
Gas	Energy Efficiency	Grocery	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	81	45	$33,177.25	15%	85%	$42.45	3,428
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	69	45	$22,972.46	15%	60%	$34.31	3,943

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hospital	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	103	45	$22,972.46	15%	60%	$23.18	8,800
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	21	45	$48,690.05	15%	50%	$250.81	381
Gas	Energy Efficiency	Hotel Motel	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	32	45	$48,690.05	15%	50%	$168.87	203
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	13	45	$8,963.15	15%	70%	$75.90	4,152
Gas	Energy Efficiency	Other Commercial	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	19	45	$8,963.15	15%	70%	$51.55	12,365
Gas	Energy Efficiency	Restaurant	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	2	45	$7,446.57	15%	80%	$465.78	498
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	768	45	$73,539.29	15%	60%	$10.51	59,957
Gas	Energy Efficiency	School	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	1141	45	$73,539.29	15%	60%	$7.04	23,536
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	1607	45	$76,975.70	15%	60%	$5.20	77,865
Gas	Energy Efficiency	University	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	2388	45	$76,975.70	15%	60%	$3.46	30,566
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	38	45	$22,232.39	15%	98%	$65.42	153
Gas	Energy Efficiency	Warehouse	Space Heat Furnace	Retrofit	Windows-High Efficiency	U-0.40 (WA State Code)	Average Existing Conditions	Existing	Per Building	56	45	$22,232.39	15%	98%	$44.01	11,191
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	15	9	$4.58	95%	75%	-$0.02	4,596
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	11	9	$4.58	95%	75%	-$0.01	1,720
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	13	9	$4.58	95%	75%	-$0.02	55,323
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	13	9	$4.58	95%	75%	-$0.02	21,403
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	183	9	$12.74	95%	75%	-$0.07	3,003
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	136	9	$12.74	95%	75%	-$0.07	1,124
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	160	9	$12.74	95%	75%	-$0.07	36,146
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	163	9	$12.74	95%	75%	-$0.07	13,982
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	322	9	$16.92	95%	75%	-$0.07	23,153
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	240	9	$16.92	95%	75%	-$0.07	8,666
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	283	9	$16.92	95%	75%	-$0.07	278,711
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	287	9	$16.92	95%	75%	-$0.07	107,812
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	250	9	$69.65	95%	75%	-$0.03	6,422
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	186	9	$69.65	95%	75%	-$0.01	2,404
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	220	9	$69.65	95%	75%	-$0.02	77,309
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	223	9	$69.65	95%	75%	-$0.03	29,905
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	25	9	$6.17	95%	75%	-$0.04	9,361

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	19	9	$6.17	95%	75%	-$0.02	3,505
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	22	9	$6.17	95%	75%	-$0.03	112,683
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	22	9	$6.17	95%	75%	-$0.03	43,599
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	17	9	$4.78	95%	75%	-$0.03	7,087
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	13	9	$4.78	95%	75%	-$0.01	2,653
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	15	9	$4.78	95%	75%	-$0.02	85,307
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	15	9	$4.78	95%	75%	-$0.03	33,003
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	69	9	$3.98	95%	75%	-$0.07	8,115
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	52	9	$3.98	95%	75%	-$0.07	3,038
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	61	9	$3.98	95%	75%	-$0.07	97,688
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	62	9	$3.98	95%	75%	-$0.07	37,788
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	142	9	$21.29	95%	75%	-$0.06	7,343
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	106	9	$21.29	95%	75%	-$0.05	2,749
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	125	9	$21.29	95%	75%	-$0.05	88,395
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	126	9	$21.29	95%	75%	-$0.05	34,193
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	252	9	$22.29	95%	75%	-$0.07	7,986
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	188	9	$22.29	95%	75%	-$0.06	2,989
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	221	9	$22.29	95%	75%	-$0.06	96,137
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	225	9	$22.29	95%	75%	-$0.06	37,190
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	54	9	$4.82	95%	75%	-$0.07	1,442
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	40	9	$4.82	95%	75%	-$0.06	540
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	Existing	Per Building	48	9	$4.82	95%	75%	-$0.06	17,364
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Low-Flow Faucet Aerators	0.5 GPM	2.2 GPM (Federal Code)	New	Per Building	48	9	$4.82	95%	75%	-$0.06	6,718
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	8	10	$61.89	95%	73%	$1.25	558
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	8	10	$61.89	95%	73%	$1.25	280
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	10	10	$61.89	95%	73%	$1.02	9,238
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	10	10	$61.89	95%	73%	$1.02	3,521
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	228	10	$1,274.18	95%	73%	$0.88	5,680
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	228	10	$1,274.18	95%	73%	$0.88	2,856

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	275	10	$1,274.18	95%	73%	$0.71	94,106
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	275	10	$1,274.18	95%	73%	$0.71	35,869
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	1	10	$14.11	95%	73%	$1.69	495
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	1	10	$14.11	95%	73%	$1.69	249
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	2	10	$14.11	95%	73%	$1.39	8,200
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	2	10	$14.11	95%	73%	$1.39	3,126
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	1	10	$10.92	95%	73%	$1.69	421
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	1	10	$10.92	95%	73%	$1.69	212
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	1	10	$10.92	95%	73%	$1.39	6,970
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	1	10	$10.92	95%	73%	$1.39	2,657
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	36	10	$347.80	95%	73%	$1.55	1,833
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	36	10	$347.80	95%	73%	$1.55	922
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	44	10	$347.80	95%	73%	$1.27	30,380
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	44	10	$347.80	95%	73%	$1.27	11,579
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	38	10	$364.05	95%	73%	$1.55	1,175
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	38	10	$364.05	95%	73%	$1.55	591
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	Existing	Per Building	46	10	$364.05	95%	73%	$1.27	19,476
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Low-Flow Showerheads	1.5 GPM	2.5 GPM (Federal Code)	New	Per Building	46	10	$364.05	95%	73%	$1.27	7,424
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$44.74	24%	25%	$6.75	28
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$44.74	24%	25%	$6.75	14
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$44.74	24%	25%	$6.75	380
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$44.74	24%	25%	$6.75	145
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$43.22	24%	25%	$6.76	1
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$43.22	24%	25%	$6.76	1
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$43.22	24%	25%	$6.76	19

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$43.22	24%	25%	$6.76	7
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$60.60	11%	25%	$6.76	4
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$60.60	11%	25%	$6.76	2
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$60.60	11%	25%	$6.76	52
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$60.60	11%	25%	$6.76	20
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	2	12	$100.47	24%	25%	$6.75	5
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	2	12	$100.47	24%	25%	$6.75	3
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	2	12	$100.47	24%	25%	$6.75	69
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	2	12	$100.47	24%	25%	$6.75	26
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	2	12	$66.59	8%	25%	$6.76	16
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	2	12	$66.59	8%	25%	$6.76	8
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	2	12	$66.59	8%	25%	$6.76	223
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	2	12	$66.59	8%	25%	$6.76	85
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$44.71	5%	25%	$6.75	8
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$44.71	5%	25%	$6.75	4
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$44.71	5%	25%	$6.75	109
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$44.71	5%	25%	$6.75	42
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0	Existing	Per Building	1	12	$46.35	46%	25%	$6.75	20

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
						gal/cycle	gal/cycle									
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$46.35	46%	25%	$6.75	10
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$46.35	46%	25%	$6.75	275
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$46.35	46%	25%	$6.75	105
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$42.00	35%	25%	$6.76	6
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$42.00	35%	25%	$6.76	3
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$42.00	35%	25%	$6.76	84
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$42.00	35%	25%	$6.76	32
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	2	12	$94.22	35%	25%	$6.76	8
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	2	12	$94.22	35%	25%	$6.76	4
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	2	12	$94.22	35%	25%	$6.76	116
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	2	12	$94.22	35%	25%	$6.76	44
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$41.61	3%	25%	$6.76	0
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$41.61	3%	25%	$6.76	0
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	Existing	Per Building	1	12	$41.61	3%	25%	$6.76	3
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Dishwasher Residential	RTF ENERGY STAR Dishwasher - 277 kWh/yr and 4.25 gal/cycle	RTF Market Standard 2014 Dishwasher - 289 kWh/yr and 5.0 gal/cycle	New	Per Building	1	12	$41.61	3%	25%	$6.76	1
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	Existing	Per Building	43	20	$671.49	10%	90%	$1.82	4,364
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	New	Per Building	24	20	$381.68	10%	90%	$1.89	1,268
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	Existing	Per Building	400	20	$1,868.27	10%	90%	$0.47	103

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	New	Per Building	84	20	$406.30	10%	90%	$0.49	10
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	Existing	Per Building	295	20	$992.53	10%	90%	$0.31	16,730
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	New	Per Building	284	20	$975.72	10%	90%	$0.32	7,794
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	Existing	Per Building	158	20	$1,021.72	10%	30%	$0.69	1,119
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	New	Per Building	112	20	$751.16	10%	30%	$0.72	393
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	Existing	Per Building	181	20	$904.95	10%	45%	$0.51	30,726
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	New	Per Building	88	20	$454.83	10%	45%	$0.53	6,913
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	Existing	Per Building	93	20	$700.62	10%	90%	$0.83	26,097
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	New	Per Building	46	20	$363.38	10%	90%	$0.86	6,758
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	Existing	Per Building	329	20	$3,123.69	10%	65%	$1.07	18,343
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	New	Per Building	275	20	$2,685.09	10%	65%	$1.10	7,714
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	Existing	Per Building	689	20	$3,269.56	10%	90%	$0.48	32,983
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	New	Per Building	575	20	$2,810.63	10%	90%	$0.50	13,708
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	Existing	Per Building	275	20	$3,532.34	10%	90%	$1.48	688
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Boiler Economizer	Economizer	No Economizer	New	Per Building	149	20	$1,988.62	10%	90%	$1.54	185
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	Existing	Per Building	36	9	$215.46	75%	75%	$1.02	6,002
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	New	Per Building	36	9	$215.46	75%	75%	$1.02	2,014
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	Existing	Per Building	3	9	$16.34	85%	75%	$1.02	3,488
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	New	Per Building	3	9	$16.34	85%	75%	$1.02	1,170
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	Existing	Per Building	9	9	$52.45	85%	75%	$1.02	4,879
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	New	Per Building	9	9	$52.45	85%	75%	$1.02	1,637
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	Existing	Per Building	9	9	$52.45	25%	75%	$1.02	15,400
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	New	Per Building	9	9	$52.45	25%	75%	$1.02	5,166
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	Existing	Per Building	268	9	$1,615.35	10%	75%	$1.02	77,717
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	New	Per Building	268	9	$1,615.35	10%	75%	$1.02	26,071
Gas	Energy Efficiency	School	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	Existing	Per Building	4	9	$24.41	50%	75%	$1.02	1,226
Gas	Energy Efficiency	School	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	New	Per Building	4	9	$24.41	50%	75%	$1.02	411
Gas	Energy Efficiency	University	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	Existing	Per Building	8	9	$46.60	50%	75%	$1.02	1,434
Gas	Energy Efficiency	University	Cooking	Retrofit	Broiler	High-Efficiency Broiler (Infrared)	Standard Broiler	New	Per Building	8	9	$46.60	50%	75%	$1.02	481

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	Existing	Per Building	10	8	$55.95	45%	85%	$1.00	1,159
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	New	Per Building	10	8	$55.95	45%	85%	$1.00	440
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	Existing	Per Building	0	8	$4.25	45%	85%	$10.53	60
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	New	Per Building	0	8	$4.25	45%	85%	$10.53	23
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	Existing	Per Building	1	8	$13.62	35%	85%	$4.69	147
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	New	Per Building	1	8	$13.62	35%	85%	$4.69	56
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	Existing	Per Building	0	8	$13.62	20%	85%	$13.85	308
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	New	Per Building	0	8	$13.62	20%	85%	$13.85	117
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	Existing	Per Building	69	8	$419.47	65%	85%	$1.11	147,945
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	New	Per Building	69	8	$419.47	65%	85%	$1.11	56,157
Gas	Energy Efficiency	School	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	Existing	Per Building	0	8	$6.34	45%	85%	$5.67	67
Gas	Energy Efficiency	School	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	New	Per Building	0	8	$6.34	45%	85%	$5.67	25
Gas	Energy Efficiency	University	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	Existing	Per Building	1	8	$12.10	45%	85%	$2.37	183
Gas	Energy Efficiency	University	Cooking	Retrofit	Fryers - Commercial Gas Cooking	Energy Star Commercial Fryer (50% efficient)	Non-Energy Star Fryer (35% efficient)	New	Per Building	1	8	$12.10	45%	85%	$2.37	70
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	Existing	Per Building	9	12	$165.10	45%	35%	$2.91	408
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	New	Per Building	9	12	$165.10	45%	35%	$2.91	155
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	Existing	Per Building	2	12	$33.40	45%	35%	$2.91	557
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	New	Per Building	2	12	$33.40	45%	35%	$2.91	212
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	Existing	Per Building	2	12	$40.20	45%	35%	$2.91	292
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	New	Per Building	2	12	$40.20	45%	35%	$2.91	111
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	Existing	Per Building	2	12	$40.20	20%	35%	$2.91	1,395
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	New	Per Building	2	12	$40.20	20%	35%	$2.91	529
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	Existing	Per Building	31	12	$582.50	75%	35%	$2.91	31,053

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	New	Per Building	31	12	$582.50	75%	35%	$2.91	11,787
Gas	Energy Efficiency	School	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	Existing	Per Building	1	12	$13.61	65%	35%	$2.91	131
Gas	Energy Efficiency	School	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	New	Per Building	1	12	$13.61	65%	35%	$2.91	50
Gas	Energy Efficiency	University	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	Existing	Per Building	1	12	$25.97	65%	35%	$2.91	153
Gas	Energy Efficiency	University	Cooking	Retrofit	Griddle	High-Efficiency Griddle (40% Efficient)	Standard Griddle (32% Efficient)	New	Per Building	1	12	$25.97	65%	35%	$2.91	58
Gas	Energy Efficiency	Dry Goods Retail	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	14	15	$1,350.28	50%	95%	$13.46	1,281
Gas	Energy Efficiency	Dry Goods Retail	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	17	15	$1,350.28	50%	95%	$11.24	15,942
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	22	15	$1,350.28	50%	95%	$8.67	6,056
Gas	Energy Efficiency	Grocery	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	176	15	$1,437.36	50%	95%	$1.06	831
Gas	Energy Efficiency	Grocery	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	211	15	$1,437.36	50%	95%	$0.87	10,352
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	76	15	$1,437.36	50%	95%	$2.53	47
Gas	Energy Efficiency	Hospital	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	310	15	$3,451.77	50%	95%	$1.48	6,555
Gas	Energy Efficiency	Hospital	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	371	15	$3,451.77	50%	95%	$1.22	81,579
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	259	15	$3,451.77	50%	95%	$1.76	37,213
Gas	Energy Efficiency	Hotel Motel	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	241	15	$2,657.37	50%	95%	$1.46	1,738
Gas	Energy Efficiency	Hotel Motel	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	289	15	$2,657.37	50%	95%	$1.21	21,666
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	102	15	$2,657.37	50%	95%	$3.56	5,643
Gas	Energy Efficiency	Office	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	24	15	$1,609.04	50%	95%	$9.27	2,671
Gas	Energy Efficiency	Office	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	29	15	$1,609.04	50%	95%	$7.74	33,224
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	80	15	$1,609.04	50%	95%	$2.72	66,170
Gas	Energy Efficiency	Other Commercial	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	17	15	$1,285.50	50%	95%	$10.76	1,848
Gas	Energy Efficiency	Other Commercial	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	20	15	$1,285.50	50%	95%	$8.98	23,236
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	42	15	$1,285.50	50%	95%	$4.18	32,263

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Restaurant	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	67	15	$813.96	50%	95%	$1.63	2,062
Gas	Energy Efficiency	Restaurant	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	80	15	$813.96	50%	95%	$1.35	26,093
Gas	Energy Efficiency	School	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	137	15	$9,499.02	50%	95%	$9.66	2,033
Gas	Energy Efficiency	School	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	164	15	$9,499.02	50%	95%	$8.06	25,363
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	250	15	$9,499.02	50%	95%	$5.22	51,063
Gas	Energy Efficiency	University	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	243	15	$9,943.12	50%	95%	$5.66	2,238
Gas	Energy Efficiency	University	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	291	15	$9,943.12	50%	95%	$4.72	27,882
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	523	15	$9,943.12	50%	95%	$2.56	65,446
Gas	Energy Efficiency	Warehouse	Water Heat GT 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	52	15	$7,035.12	50%	95%	$18.84	410
Gas	Energy Efficiency	Warehouse	Water Heat LE 55 Gal	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	62	15	$7,035.12	50%	95%	$15.73	5,096
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Integrated Space Heating/Water Heating	Integrated System	Separate Boiler And HW Heater	New	Per Building	136	15	$7,035.12	50%	95%	$7.15	883
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	Existing	Per Building	648	10	$142.65	5%	85%	-$0.05	8,204
Gas	Energy Efficiency	Grocery	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	New	Per Building	648	10	$142.65	5%	85%	-$0.05	2,623
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	Existing	Per Building	66	10	$10.82	5%	85%	-$0.06	5,679
Gas	Energy Efficiency	Hospital	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	New	Per Building	66	10	$10.82	5%	85%	-$0.06	1,816
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	Existing	Per Building	147	10	$34.72	5%	85%	-$0.04	5,491
Gas	Energy Efficiency	Hotel Motel	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	New	Per Building	147	10	$34.72	5%	85%	-$0.04	1,756
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	Existing	Per Building	50	10	$34.72	5%	85%	$0.03	20,205
Gas	Energy Efficiency	Other Commercial	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	New	Per Building	50	10	$34.72	5%	85%	$0.03	6,461
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	Existing	Per Building	589	10	$1,069.51	35%	85%	$0.23	676,847
Gas	Energy Efficiency	Restaurant	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	New	Per Building	589	10	$1,069.51	35%	85%	$0.23	216,424
Gas	Energy Efficiency	School	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	Existing	Per Building	122	10	$16.16	5%	85%	-$0.06	4,187
Gas	Energy Efficiency	School	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	New	Per Building	122	10	$16.16	5%	85%	-$0.06	1,339
Gas	Energy Efficiency	University	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	Existing	Per Building	287	10	$30.85	5%	85%	-$0.06	6,018
Gas	Energy Efficiency	University	Cooking	Retrofit	Oven - Conveyor	High-Efficiency Model (23% Efficient)	Standard Model (15% Efficient)	New	Per Building	287	10	$30.85	5%	85%	-$0.06	1,924
Gas	Energy Efficiency	Dry Goods Retail	Space Heat Boiler	Retrofit	Pipe Insulation - Boiler	3" of Insulation, assuming R-12 (WA State Code)	No Insulation	Existing	Per Building	95	20	$2,340.39	75%	65%	$2.96	51,539

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Grocery	Space Heat Boiler	Retrofit	Pipe Insulation - Boiler	3" of Insulation, assuming R-12 (WA State Code)	No Insulation	Existing	Per Building	876	20	$2,374.56	75%	65%	$0.23	1,213
Gas	Energy Efficiency	Hospital	Space Heat Boiler	Retrofit	Pipe Insulation - Boiler	3" of Insulation, assuming R-12 (WA State Code)	No Insulation	Existing	Per Building	647	20	$2,234.76	75%	65%	$0.32	197,581
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Pipe Insulation - Boiler	3" of Insulation, assuming R-12 (WA State Code)	No Insulation	Existing	Per Building	345	20	$1,966.33	75%	65%	$0.60	39,782
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Pipe Insulation - Boiler	3" of Insulation, assuming R-12 (WA State Code)	No Insulation	Existing	Per Building	396	20	$1,061.94	75%	65%	$0.22	727,539
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Pipe Insulation - Boiler	3" of Insulation, assuming R-12 (WA State Code)	No Insulation	Existing	Per Building	203	20	$4,151.85	75%	65%	$2.43	308,197
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Pipe Insulation - Boiler	3" of Insulation, assuming R-12 (WA State Code)	No Insulation	Existing	Per Building	721	20	$4,415.11	75%	65%	$0.65	300,354
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Pipe Insulation - Boiler	3" of Insulation, assuming R-12 (WA State Code)	No Insulation	Existing	Per Building	1509	20	$1,924.92	75%	65%	$0.05	389,521
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Pipe Insulation - Boiler	3" of Insulation, assuming R-12 (WA State Code)	No Insulation	Existing	Per Building	603	20	$3,210.99	75%	65%	$0.55	8,127
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	Existing	Per Building	1003	10	$57,675.89	25%	98%	$9.73	54,655
Gas	Energy Efficiency	Hotel Motel	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	New	Per Building	711	10	$57,675.89	75%	98%	$13.77	59,674
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	Existing	Per Building	1151	10	$51,084.35	25%	98%	$7.49	999,540
Gas	Energy Efficiency	Office	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	New	Per Building	557	10	$51,084.35	75%	98%	$15.58	699,707
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	Existing	Per Building	589	10	$39,549.18	25%	98%	$11.38	423,421
Gas	Energy Efficiency	Other Commercial	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	New	Per Building	294	10	$39,549.18	75%	98%	$22.88	341,156
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent	No Heat Recovery	Existing	Per Building	2094	10	$176,323.42	25%	98%	$14.30	412,645

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
						recovery effectiveness										
Gas	Energy Efficiency	School	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	New	Per Building	1749	10	$176,323.42	75%	98%	$17.14	539,952
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	Existing	Per Building	4383	10	$184,562.83	25%	98%	$7.10	535,148
Gas	Energy Efficiency	University	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	New	Per Building	3662	10	$184,562.83	75%	98%	$8.52	692,048
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	Existing	Per Building	1752	10	$199,393.77	25%	98%	$19.37	11,166
Gas	Energy Efficiency	Warehouse	Space Heat Boiler	Retrofit	Sensible And Total Heat Recovery Devices	Install Heat Recovery Devices - rotary air-to-air enthalpy heat recovery- 70% sensible and latent recovery effectiveness	No Heat Recovery	New	Per Building	951	10	$199,393.77	75%	98%	$35.77	9,341
Gas	Energy Efficiency	Hotel Motel	Pool Heat	Retrofit	Swimming Pool/Spa Covers	Automatic Plastic Or Foam Pool Covers (50-65% Energy Savings)	No Pool Covers	Existing	Per Building	1141	10	$890.56	3%	35%	$0.05	3,656
Gas	Energy Efficiency	Hotel Motel	Pool Heat	Retrofit	Swimming Pool/Spa Covers	Automatic Plastic Or Foam Pool Covers (50-65% Energy Savings)	No Pool Covers	New	Per Building	1141	10	$890.56	3%	35%	$0.05	1,393
Gas	Energy Efficiency	Other Commercial	Pool Heat	Retrofit	Swimming Pool/Spa Covers	Automatic Plastic Or Foam Pool Covers (50-65% Energy Savings)	No Pool Covers	Existing	Per Building	1141	10	$890.56	3%	35%	$0.05	23,254
Gas	Energy Efficiency	Other Commercial	Pool Heat	Retrofit	Swimming Pool/Spa Covers	Automatic Plastic Or Foam Pool Covers (50-65% Energy Savings)	No Pool Covers	New	Per Building	1141	10	$890.56	3%	35%	$0.05	8,864
Gas	Energy Efficiency	School	Pool Heat	Retrofit	Swimming Pool/Spa Covers	Automatic Plastic Or Foam Pool Covers (50-65% Energy Savings)	No Pool Covers	Existing	Per Building	4911	10	$890.56	3%	35%	-$0.05	9,180
Gas	Energy Efficiency	School	Pool Heat	Retrofit	Swimming Pool/Spa Covers	Automatic Plastic Or Foam Pool Covers (50-65% Energy Savings)	No Pool Covers	New	Per Building	4911	10	$890.56	3%	35%	-$0.05	3,499
Gas	Energy Efficiency	University	Pool Heat	Retrofit	Swimming Pool/Spa Covers	Automatic Plastic Or Foam Pool Covers (50-65% Energy Savings)	No Pool Covers	Existing	Per Building	4911	10	$890.56	3%	35%	-$0.05	5,623
Gas	Energy Efficiency	University	Pool Heat	Retrofit	Swimming Pool/Spa Covers	Automatic Plastic Or Foam Pool Covers (50-65% Energy Savings)	No Pool Covers	New	Per Building	4911	10	$890.56	3%	35%	-$0.05	2,143

Table 6 – Industrial Gas Measure Detail

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Chemical Mfg	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	3385	15	$3,185.44	100%	100%	$0.05	2,270
Gas	Energy Efficiency	Chemical Mfg	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	2256	2	$2,496.13	100%	100%	$0.56	1,512
Gas	Energy Efficiency	Chemical Mfg	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	13446	15	$3,485.32	100%	100%	-$0.04	9,016
Gas	Energy Efficiency	Chemical Mfg	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	19626	2	$3,228.43	100%	100%	$0.02	13,159
Gas	Energy Efficiency	Chemical Mfg	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	58546	15	$3,787.94	100%	100%	-$0.07	39,255
Gas	Energy Efficiency	Chemical Mfg	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	29584	15	$10,709.38	100%	100%	-$0.03	19,836
Gas	Energy Efficiency	Chemical Mfg	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	1621	2	$866.28	100%	100%	$0.23	1,087
Gas	Energy Efficiency	Chemical Mfg	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	40519	15	$2,216.39	100%	100%	-$0.07	27,167
Gas	Energy Efficiency	Chemical Mfg	Process Other	Retrofit	Other O&M	Other O&M		Existing	Per Industry	8679	2	$2,411.91	100%	100%	$0.08	5,819
Gas	Energy Efficiency	Computer Electronic Mfg	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	79426	15	$59,021.37	100%	100%	$0.03	53,254
Gas	Energy Efficiency	Computer Electronic Mfg	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	98419	2	$37,497.65	100%	100%	$0.14	65,989
Gas	Energy Efficiency	Computer Electronic Mfg	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	99701	15	$117,018.50	100%	100%	$0.09	66,848
Gas	Energy Efficiency	Computer Electronic Mfg	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	75959	2	$10,231.63	100%	100%	$0.00	50,929
Gas	Energy Efficiency	Computer Electronic Mfg	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	5950	15	$10,073.68	100%	100%	$0.16	3,990
Gas	Energy Efficiency	Computer Electronic Mfg	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	32199	15	$11,797.83	100%	100%	-$0.03	21,589
Gas	Energy Efficiency	Computer Electronic Mfg	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	5745	2	$3,350.58	100%	100%	$0.26	3,852
Gas	Energy Efficiency	Computer Electronic Mfg	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	13123	15	$6,465.47	100%	100%	-$0.01	8,798
Gas	Energy Efficiency	Electrical Equipment Mfg	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	16099	15	$9,702.83	100%	100%	$0.01	10,794
Gas	Energy Efficiency	Electrical Equipment Mfg	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	7082	2	$1,284.67	100%	100%	$0.03	4,748
Gas	Energy Efficiency	Electrical Equipment Mfg	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	16278	15	$18,424.86	100%	100%	$0.08	10,914
Gas	Energy Efficiency	Electrical Equipment Mfg	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	17476	2	$3,972.19	100%	100%	$0.05	11,717
Gas	Energy Efficiency	Electrical Equipment Mfg	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	31221	15	$16,531.76	100%	100%	$0.00	20,934
Gas	Energy Efficiency	Electrical Equipment Mfg	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	73102	15	$41,112.80	100%	100%	$0.00	49,014
Gas	Energy Efficiency	Electrical Equipment Mfg	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	10724	2	$4,609.04	100%	100%	$0.17	7,190
Gas	Energy Efficiency	Electrical Equipment Mfg	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	26747	15	$9,048.57	100%	100%	-$0.03	17,934
Gas	Energy Efficiency	Fabricated Metal Products	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	72362	15	$88,353.73	100%	100%	$0.09	48,518
Gas	Energy Efficiency	Fabricated Metal Products	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	64781	2	$44,835.27	100%	100%	$0.32	43,435
Gas	Energy Efficiency	Fabricated Metal Products	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	91351	15	$143,219.50	100%	100%	$0.14	61,249

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Fabricated Metal Products	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	62520	2	$7,002.21	100%	100%	-$0.01	41,919
Gas	Energy Efficiency	Fabricated Metal Products	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	131107	15	$62,118.73	100%	100%	-$0.01	87,906
Gas	Energy Efficiency	Fabricated Metal Products	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	150161	15	$136,631.38	100%	100%	$0.05	100,681
Gas	Energy Efficiency	Fabricated Metal Products	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	77380	2	$36,902.33	100%	100%	$0.20	51,882
Gas	Energy Efficiency	Fabricated Metal Products	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	113836	15	$73,982.18	100%	100%	$0.01	76,326
Gas	Energy Efficiency	Fabricated Metal Products	Process Other	Retrofit	Other O&M	Other O&M		Existing	Per Industry	1825	2	$895.36	100%	100%	$0.21	1,223
Gas	Energy Efficiency	Food Mfg	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	33404	15	$19,531.35	100%	100%	$0.00	22,397
Gas	Energy Efficiency	Food Mfg	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	9191	2	$1,920.00	100%	100%	$0.04	6,162
Gas	Energy Efficiency	Food Mfg	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	115654	15	$94,570.56	100%	100%	$0.04	77,545
Gas	Energy Efficiency	Food Mfg	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	80024	2	$28,696.48	100%	100%	$0.13	53,655
Gas	Energy Efficiency	Food Mfg	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	81234	15	$25,791.68	100%	100%	-$0.03	54,466
Gas	Energy Efficiency	Food Mfg	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	147801	15	$74,595.41	100%	100%	-$0.01	99,099
Gas	Energy Efficiency	Food Mfg	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	40462	2	$14,089.00	100%	100%	$0.12	27,130
Gas	Energy Efficiency	Food Mfg	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	59613	15	$27,433.68	100%	100%	-$0.01	39,969
Gas	Energy Efficiency	Food Mfg	Process Other	Retrofit	Other O&M	Other O&M		Existing	Per Industry	34825	2	$4,812.85	100%	100%	$0.00	23,350
Gas	Energy Efficiency	Industrial Machinery	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	179940	15	$147,713.12	100%	100%	$0.04	120,648
Gas	Energy Efficiency	Industrial Machinery	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	182448	2	$62,853.45	100%	100%	$0.12	122,329
Gas	Energy Efficiency	Industrial Machinery	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	157411	15	$162,448.49	100%	100%	$0.07	105,542
Gas	Energy Efficiency	Industrial Machinery	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	126063	2	$21,733.23	100%	100%	$0.02	84,524
Gas	Energy Efficiency	Industrial Machinery	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	20876	15	$22,808.68	100%	100%	$0.08	13,997
Gas	Energy Efficiency	Industrial Machinery	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	132717	15	$67,367.18	100%	100%	-$0.01	88,985
Gas	Energy Efficiency	Industrial Machinery	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	97316	2	$55,518.67	100%	100%	$0.25	65,249
Gas	Energy Efficiency	Industrial Machinery	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	62286	15	$22,659.55	100%	100%	-$0.03	41,762
Gas	Energy Efficiency	Miscellaneous Mfg	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	633583	15	$443,064.38	50%	100%	$0.02	212,405
Gas	Energy Efficiency	Miscellaneous Mfg	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	767229	2	$35,829.60	50%	100%	-$0.05	257,209
Gas	Energy Efficiency	Miscellaneous Mfg	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	181368	15	$107,152.29	50%	100%	$0.01	60,803
Gas	Energy Efficiency	Miscellaneous Mfg	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	69247	2	$14,569.64	50%	100%	$0.04	23,215
Gas	Energy Efficiency	Miscellaneous Mfg	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	69298	15	$72,527.40	50%	100%	$0.07	23,232
Gas	Energy Efficiency	Miscellaneous Mfg	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	128808	15	$59,277.23	50%	100%	-$0.01	43,182

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Miscellaneous Mfg	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	56273	2	$18,677.00	50%	100%	$0.11	18,865
Gas	Energy Efficiency	Miscellaneous Mfg	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	186255	15	$39,746.72	50%	100%	-$0.05	62,441
Gas	Energy Efficiency	Nonmetallic Mineral Products	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	6641	15	$7,695.26	100%	100%	$0.09	4,453
Gas	Energy Efficiency	Nonmetallic Mineral Products	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	1186	2	$547.21	100%	100%	$0.19	795
Gas	Energy Efficiency	Nonmetallic Mineral Products	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	3450	2	$231.13	100%	100%	-$0.04	2,313
Gas	Energy Efficiency	Nonmetallic Mineral Products	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	273992	15	$54,853.26	100%	100%	-$0.05	183,708
Gas	Energy Efficiency	Nonmetallic Mineral Products	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	162105	15	$146,267.13	100%	100%	$0.05	108,689
Gas	Energy Efficiency	Nonmetallic Mineral Products	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	38185	2	$11,524.30	100%	100%	$0.10	25,603
Gas	Energy Efficiency	Nonmetallic Mineral Products	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	58297	15	$23,884.41	100%	100%	-$0.02	39,088
Gas	Energy Efficiency	Nonmetallic Mineral Products	Process Other	Retrofit	Other O&M	Other O&M		Existing	Per Industry	3323	2	$6,480.01	100%	100%	$1.05	2,228
Gas	Energy Efficiency	Paper Mfg	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	2434	15	$1,612.29	100%	100%	$0.02	1,632
Gas	Energy Efficiency	Paper Mfg	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	2926	2	$401.18	100%	100%	$0.00	1,962
Gas	Energy Efficiency	Paper Mfg	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	21355	15	$10,149.88	100%	100%	-$0.01	14,318
Gas	Energy Efficiency	Paper Mfg	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	11322	2	$1,377.84	100%	100%	-$0.01	7,591
Gas	Energy Efficiency	Paper Mfg	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	7651	15	$3,709.28	100%	100%	-$0.01	5,130
Gas	Energy Efficiency	Paper Mfg	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	12734	15	$8,642.25	100%	100%	$0.02	8,538
Gas	Energy Efficiency	Paper Mfg	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	3796	2	$917.76	100%	100%	$0.06	2,545
Gas	Energy Efficiency	Paper Mfg	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	4614	15	$820.41	100%	100%	-$0.05	3,094
Gas	Energy Efficiency	Paper Mfg	Process Other	Retrofit	Other O&M	Other O&M		Existing	Per Industry	3669	2	$2,439.36	100%	100%	$0.31	2,460
Gas	Energy Efficiency	Petroleum Coal Products	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	5697	15	$5,226.81	100%	100%	$0.05	3,820
Gas	Energy Efficiency	Petroleum Coal Products	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	3764	2	$644.46	100%	100%	$0.02	2,524
Gas	Energy Efficiency	Petroleum Coal Products	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	2236	15	$1,715.94	100%	100%	$0.03	1,499
Gas	Energy Efficiency	Petroleum Coal Products	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	5625	15	$4,207.72	100%	100%	$0.03	3,772
Gas	Energy Efficiency	Petroleum Coal Products	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	2671	2	$511.98	100%	100%	$0.03	1,791
Gas	Energy Efficiency	Petroleum Coal Products	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	3540	15	$175.56	100%	100%	-$0.07	2,373
Gas	Energy Efficiency	Plastics Rubber Products	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	21235	15	$13,405.63	100%	100%	$0.01	14,238
Gas	Energy Efficiency	Plastics Rubber Products	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	28549	2	$889,660.23	100%	100%	$17.98	19,142
Gas	Energy Efficiency	Plastics Rubber Products	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	66561	15	$20,500.64	100%	100%	-$0.03	44,628
Gas	Energy Efficiency	Plastics Rubber Products	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	34207	2	$7,628.08	100%	100%	$0.05	22,935

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Plastics Rubber Products	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	30414	15	$19,154.43	100%	100%	$0.01	20,392
Gas	Energy Efficiency	Plastics Rubber Products	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	38921	15	$24,457.95	100%	100%	$0.01	26,096
Gas	Energy Efficiency	Plastics Rubber Products	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	25010	2	$15,540.98	100%	100%	$0.28	16,769
Gas	Energy Efficiency	Plastics Rubber Products	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	20039	15	$3,176.11	100%	100%	-$0.06	13,436
Gas	Energy Efficiency	Plastics Rubber Products	Process Other	Retrofit	Other O&M	Other O&M		Existing	Per Industry	9501	2	$1,817.54	100%	100%	$0.03	6,370
Gas	Energy Efficiency	Primary Metal Mfg	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	2772	15	$1,282.15	100%	100%	-$0.01	1,858
Gas	Energy Efficiency	Primary Metal Mfg	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	5335	15	$5,245.22	100%	100%	$0.06	3,577
Gas	Energy Efficiency	Primary Metal Mfg	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	4080	2	$594.50	100%	100%	$0.01	2,736
Gas	Energy Efficiency	Primary Metal Mfg	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	18613	15	$8,074.37	100%	100%	-$0.02	12,480
Gas	Energy Efficiency	Primary Metal Mfg	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	19996	15	$14,858.92	100%	100%	$0.03	13,407
Gas	Energy Efficiency	Primary Metal Mfg	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	3937	2	$1,919.85	100%	100%	$0.21	2,640
Gas	Energy Efficiency	Primary Metal Mfg	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	10043	15	$3,893.85	100%	100%	-$0.02	6,734
Gas	Energy Efficiency	Printing Related Support	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	66672	15	$29,322.46	100%	100%	-$0.02	44,703
Gas	Energy Efficiency	Printing Related Support	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	118014	2	$39,015.59	100%	100%	$0.11	79,127
Gas	Energy Efficiency	Printing Related Support	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	33724	15	$35,163.90	100%	100%	$0.07	22,611
Gas	Energy Efficiency	Printing Related Support	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	28208	2	$3,652.93	100%	100%	$0.00	18,913
Gas	Energy Efficiency	Printing Related Support	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	222004	15	$387,508.38	100%	100%	$0.17	148,851
Gas	Energy Efficiency	Printing Related Support	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	63761	15	$28,303.67	100%	100%	-$0.02	42,751
Gas	Energy Efficiency	Printing Related Support	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	59693	2	$35,923.04	100%	100%	$0.27	40,023
Gas	Energy Efficiency	Printing Related Support	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	235931	15	$85,406.91	100%	100%	-$0.03	158,189
Gas	Energy Efficiency	Transportation Equipment Mfg	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	73322	15	$72,457.26	100%	100%	$0.06	49,162
Gas	Energy Efficiency	Transportation Equipment Mfg	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	137141	2	$25,357.42	100%	100%	$0.03	91,952
Gas	Energy Efficiency	Transportation Equipment Mfg	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	91263	15	$90,569.66	100%	100%	$0.06	61,191
Gas	Energy Efficiency	Transportation Equipment Mfg	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	30181	2	$21,434.64	100%	100%	$0.33	20,236
Gas	Energy Efficiency	Transportation Equipment Mfg	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	133491	15	$32,812.15	100%	100%	-$0.04	89,504
Gas	Energy Efficiency	Transportation Equipment Mfg	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	172904	15	$55,432.95	100%	100%	-$0.03	115,930
Gas	Energy Efficiency	Transportation Equipment Mfg	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	30296	2	$22,230.94	100%	100%	$0.35	20,313
Gas	Energy Efficiency	Transportation Equipment Mfg	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	47048	15	$389,549.41	100%	100%	$1.08	31,545
Gas	Energy Efficiency	Transportation Equipment Mfg	Process Other	Retrofit	Other O&M	Other O&M		Existing	Per Industry	10484	2	$4,403.25	100%	100%	$0.17	7,029

Fuel Type	Resource Type	Segment	End Use	Measure Type	Measure Name	Measure Description	Baseline Description	Construction Vintage	Unit Description	Savings per Unit [therm]	Measure Life	Incremental Cost per Unit	Percent of Installations Technically Feasible	Percent of Installations Incomplete	TRC Levelized Cost [$/therm]	2035 Cumulative Technical Achievable Potential [therm]
Gas	Energy Efficiency	Wood Product Mfg	Hvac	Retrofit	HVAC Improvements	HVAC Improvements		Existing	Per Industry	9690	15	$10,600.43	100%	100%	$0.08	6,497
Gas	Energy Efficiency	Wood Product Mfg	Hvac	Retrofit	HVAC O&M	HVAC O&M		Existing	Per Industry	4461	2	$777.59	100%	100%	$0.02	2,991
Gas	Energy Efficiency	Wood Product Mfg	Indirect Boiler	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	47860	15	$22,858.00	100%	100%	-$0.01	32,090
Gas	Energy Efficiency	Wood Product Mfg	Indirect Boiler	Retrofit	Boiler O&M	Boiler O&M		Existing	Per Industry	14208	2	$1,125.27	100%	100%	-$0.03	9,526
Gas	Energy Efficiency	Wood Product Mfg	Process Heat	Retrofit	Boiler Improvements	Boiler Improvements		Existing	Per Industry	86358	15	$29,370.42	100%	100%	-$0.03	57,902
Gas	Energy Efficiency	Wood Product Mfg	Process Heat	Retrofit	Heat Improvements	Heat Improvements		Existing	Per Industry	60738	15	$134,055.60	100%	100%	$0.23	40,724
Gas	Energy Efficiency	Wood Product Mfg	Process Heat	Retrofit	Heat O&M	Heat O&M		Existing	Per Industry	43936	2	$4,890.07	100%	100%	-$0.01	29,459
Gas	Energy Efficiency	Wood Product Mfg	Process Heat	Retrofit	Steam Distribution	Steam Distribution		Existing	Per Industry	11118	15	$880.57	100%	100%	-$0.07	7,455
Gas	Energy Efficiency	Wood Product Mfg	Process Other	Retrofit	Other O&M	Other O&M		Existing	Per Industry	3402	2	$532.82	100%	100%	$0.01	2,281

COLSTRIP

Contents

This appendix describes the Colstrip generating plant, its ownership structure, governance agreements and the history of the site. It explains plant operations and describes the measures the plant employs to minimize environmental impacts. Finally, it summarizes the rules and regulations that may impact the plant's future operation.[1]

For discussion of the Colstrip sensitivities modeled in the 2015 IRP, see Chapter 6, Electric Analysis and Appendix N.

1 / Potential future CO_2 regulation is incorporated in the overall scenarios for the IRP since it impacts all thermal resources. Since Colstrip is included among these, CO_2 is not treated separately here.

FACILITY DESCRIPTION

The Colstrip generating plant supplies PSE customers with reliable, low-cost electric power. It also contributes diversity to the electric resource portfolio. Currently the facility supplies 18 to 20 percent of the energy needed to serve PSE's energy needs on an annual basis. The plant consists of four coal-fired steam electric plant units located in eastern Montana about 120 miles southeast of Billings. It was built in two phases.

- Units 1 & 2 began operation in 1975 and 1976, respectively. Each produces up to 307 megawatts (MW) net. PSE and Talen Energy (formerly PPL Montana) each own a 50 percent undivided interest in both units.
- Units 3 & 4 began operation in 1984 and 1986, respectively. Each produces up to 740 MW net. Six companies participate in the ownership of Units 3 & 4. PSE owns 25 percent each of Units 3 & 4, Portland General Electric (PGE) owns 20 percent of both units, Avista owns 15 percent of both units and PacifiCorp owns 10 percent of both. Talen Energy owns 30 percent of Unit 3 and NorthWestern Energy owns 30 percent of Unit 4.

Figure K-1 summarizes ownership of the Colstrip plant.

Figure K-1: Colstrip Ownership Share by Unit and Owner

Owner		Unit 1	Unit 2	Unit 3	Unit 4	Ownership Total, MW	% of Total Plant
Puget Sound Energy	% MW	50% 153.5	50% 153.5	25% 185	25% 185	677	32.3%
Talen Energy		50% 153.5	50% 153.5	30% 222		529	25.3%
NorthWestern Energy					30% 222	222	10.6%
PGE				20% 148	20% 148	296	14.1%
Avista				15% 111	15% 111	222	10.6%
PacifiCorp				10% 74	10% 74	148	7.1%
Total		307	307	740	740	2094	100.0%

The Colstrip Transmission System was built at the same time as Units 3 & 4. This transmission system consists of two single-circuit 500 kV transmission lines that run from the plant to an interconnection with the Bonneville Power Administration (BPA) in Townsend, Montana. It is owned by the five regulated utility owners of the power plant: PSE, NorthWestern Energy, PGE, Avista and PacifiCorp.

Governance

Colstrip owners are governed by two ownership agreements. The Units 1 & 2 Construction and Ownership Agreement executed in 1971 and the Colstrip Units 3 & 4 Ownership and Operations Agreement executed in 1981. There is a separate Operating Agreement for Units 1 & 2.

Each agreement establishes an Owners Committee to guide operating decisions, and the agreements set forth several key conditions.

- Ownership is as "tenants in common," without a right of partition, and the obligations of each owner are several and not joint.
- Assignment and ownership transfer to third parties is limited, with a right of first refusal for an existing owner to acquire any ownership offered for sale.
- The term of the agreements continues for as long as the units are used and useful or to the end of the period permitted by law.
- Each owner must provide enough fuel to operate its share of the units at minimum load.
- Failing to pay its share of project costs or failing to provide adequate fuel constitutes a default on the part of the owner.
- An owner must continue to pay its share of operating costs and coal costs until it has transferred its ownership to another entity.
- No single owner has the ability or right to shut down the plant, so to shut down and decommission any unit all owners of that unit must unanimously agree.
- The ownership contracts do not establish a "put" right for any owner.

The Operating and Ownership Agreement for Units 3 & 4 specifies a voting structure to be used by the Owners Committee for approving annual budgets and other operating decisions. Both ownership agreements provide that the Owners Committee may not amend the agreement. A separate agreement governs ownership and operation of the Colstrip Transmission System.

Requirements after Operations Cease

Potential Plant Remediation Obligations. The Ownership Agreements for both Units 1 & 2 and Units 3 & 4 are silent about a definite date for shutdown of the units. They address decommissioning or remediation costs only to the extent that costs remaining after equipment salvage are to be distributed based on ownership share. Currently there are no plans for decommissioning of the facility.

Potential Mine Reclamation and Obligations. Mining permits held by Western Energy Company (WECo), the coal supplier, require development of reclamation plans and cost estimates for all areas disturbed by mining, and WECo has provided surety bonds to the State of Montana to ensure that reclamation will occur. Plant owners reimburse WECo for the cost of mine reclamation, including final reclamation work after coal deliveries cease, as part of the current costs paid for each ton of coal supplied.

Wastewater Remediation. In August 2012, Talen Energy and the Montana Department of Environmental Quality (MDEQ) signed an Administrative Order of Consent Regarding Impacts from Wastewater Facilities (AOC). The AOC sets up a comprehensive program for investigation, interim response and remediation of any wastewater seepage or spills, and closure of the holding ponds. The AOC provides for preparation of a Site Report for any identified area of the plant site where seepage or spills have occurred. A Site Report must include a description of investigations performed to date in that area, results of modeling, details of pond construction and recommendations for additional characterization. After the Site Report is complete for a given area, a Site Characterization Work Plan, a Cleanup Criteria and Risk Assessment, a Remedy Evaluation Report and, if required, a Final Remediation Action Report will be completed and approved by the MDEQ. The AOC provides for public notice and comment on each report and response by MDEQ to substantive comments. Separately a plan for closure of the wastewater ponds must be prepared and submitted by August 2017. This plan will include requirements for wastewater pond closure which must be completed when operations cease.

Coal Combustion Residuals (CCR) Pond Closure and Related Remediation. On April 17, 2015, the United States Environmental Protection Agency (EPA) published a final rule, effective October 19, 2015, that regulates Coal Combustion Residuals (CCRs) under the Resource Conservation and Recovery Act, Subtitle D. This rule requires significant changes to the Colstrip operations and post-closure requirements. The changes were reviewed by PSE and the plant operator in the second quarter of 2015. Refer to the section below titled "Rules and Proposed Rules" for additional information regarding CCR.

The History of Colstrip

The Northern Pacific Railway established the town of Colstrip in 1924 at the northern end of the Powder River Basin to provide coal for its steam locomotives. The Powder River Basin is the single largest source of coal in the United States and is one of the largest deposits of coal in the world. At Colstrip, coal is mined from the Rosebud seam of the Fort Union Formation. The railroad shut down the mine in 1958 when it switched to diesel locomotives, and the Montana Power Company purchased the rights to the mine and the town in 1959. They resumed mining operations in the 1970s with plans to build coal-fired electrical plants.

In the 1960s, BPA forecast that available baseload hydroelectric power would be fully subscribed by its statutory preference customers, leaving none available for sale to PSE and other investor-owned utilities. Faced with this situation, PSE had to develop or contract for other sources of baseload energy. Developing a coal-fired generating plant at Colstrip, Montana was the result. The adjacent Rosebud mine offered plentiful coal reserves that could be delivered to the generating plant without the need for costly rail facilities. Sharing the ownership and output of a two-unit plant with Montana Power Company (whose generating plants were later acquired by Talen Energy) made construction and operation more economical, and sharing the output of two units increased reliability compared to owning a single unit of similar size or a larger, single-unit plant.

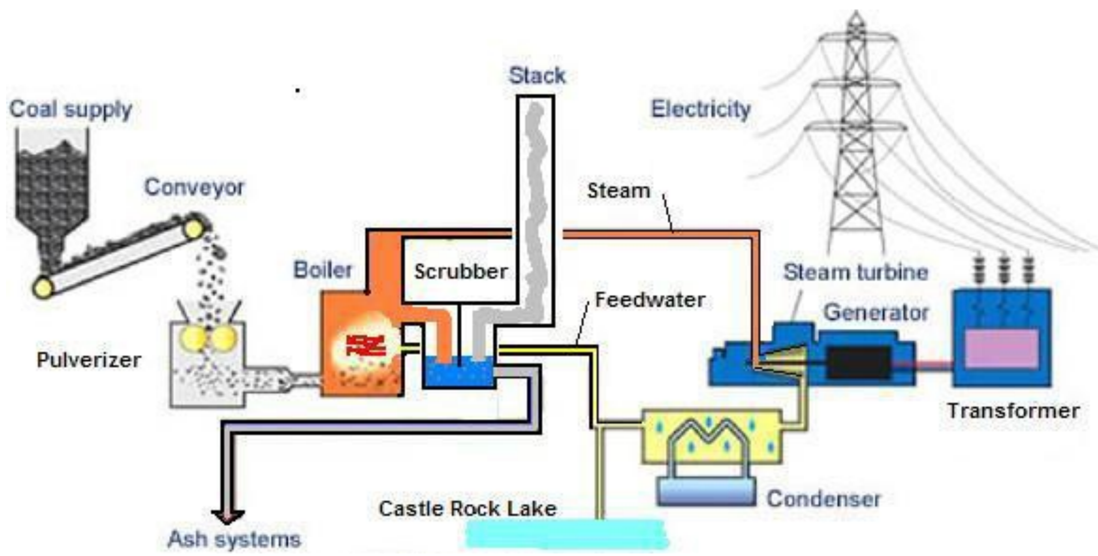
In the early 1970s, under the same forecast that the region's investor-owned utilities would soon lose access to BPA baseload hydro power, PSE and Montana Power Company began planning for Units 3 & 4 together with three other utilities. Construction of the two units began, but delays in obtaining the required Montana Major Facility Siting Act Certificate postponed their opening until 1984 and 1986 respectively. The 500 kV Colstrip Transmission System was constructed in tandem with Units 3 & 4.

The power plant and mine dominate the economies of Colstrip and Rosebud County, although ranching is also an important source of jobs and income. A 2010 study by University of Montana economists estimated that the plant and mine support more than 3,700 jobs, $360 million of personal income and over $100 million of annual tax payments to the State of Montana and county and local governments.

Plant Operations

Each of Colstrip Units 1 & 2 consists of a fuel supply system, a coal-fired boiler, a steam turbine-generator, a cooling tower, step-up transformers, piping, and electric distribution and auxiliary equipment. Figure K-2 provides a simplified illustration of how each of Colstrip Units 1 & 2 generates electricity.

Figure K-2: Colstrip Plant Operations Diagram



How Colstrip Generates Electricity. Coal from the Rosebud Mine is crushed into 3-inch chunks and transported to the generating plant on overland conveyors or in trucks where it is stored in piles at the plant site before being moved to silos in the boiler buildings. Coal travels through a pulverizer that grinds it to the consistency of talcum powder. The pulverized coal is then mixed with air and blown into the boiler. Inside the boiler, the coal and air mixture burns, releasing hot gases that convert water in boiler tubes to steam. The steam powers turbines connected to electric generators, which transform the mechanical energy from the turbine into electric energy.

Afterwards, the hot gases are drawn into the scrubbers, where they are cleaned before being exhausted through the stack. Bottom ash, the heavier of the two residuals, sinks to the bottom of the boiler where it is collected for treatment and storage. The lighter fly ash is pulled into the scrubbers with the flue gases, where it is captured for treatment and storage. The scrubbers also capture sulfur and mercury emitted from the coal during combustion.

Water for plant operations comes from the Yellowstone River. A 30-day supply is maintained in Castle Rock Lake, a man-made lake constructed as part of the plant facilities. As water enters the plant it is divided into two streams. The largest flows to the cooling towers where it replaces water lost from evaporation, the smaller flow is used for various processes including equipment cooling and scrubber system make-up. Water used in the boilers is demineralized before entering a closed-loop system that passes through the boiler and turbine system.

Environmental Impact Measures.

Nearly every step of the process includes measures to reduce environmental impacts.

NO_X. Coal and air leaving the pulverizers passes though burner systems and over-fire air systems that cool the flame temperature and reduce the formation of nitrogen oxides (NO_X). Units 1 & 2 use a second-generation low-NO_X combustion system with a close-coupled over-fire air injection. The newer Units 3 & 4 use a third-generation combustion system with separated over-fire air injection. Digital control systems recently installed on all four units further enhance NO_X emissions control.

MERCURY. Coal contains mercury. To oxidize the mercury and enhance its capture, the coal is treated with a bromine solution before entering the boiler. Then, flue gases are treated with powdered activated carbon to capture the mercury before the gases enter the scrubbers; there, the activated carbon and mercury are removed along with other particulate matter.

SO_2. Permit specifications limit the amount of sulfur in the coal fuel. Additionally, all four units remove sulfur dioxide from flue gases using wet alkali scrubbers. These scrubbers use the alkalinity of fly ash and/or hydrated lime to capture SO_2; then a water spray collects the fly ash and the mercury for further processing.

COAL COMBUSTION RESIDUALS (CCR). Two types of ash are produced by coal combustion. Bottom ash makes up 30 percent to 35 percent of the total. Fly ash makes up the remainder. The larger and heavier bottom ash falls into a water-filled trough in the bottom of the boiler; from there it is pumped to settling ponds on the plant site and then to permanent storage ponds. Some bottom ash is used as a construction material.

The smaller and lighter fly ash and other particulate matter (PM) passes into the scrubbers with the flue gases. The scrubbers use the fly ash's alkalinity and/or hydrated lime to capture SO_2 gases, and a water spray removes the fly ash and other PM. The resulting scrubber slurry is piped to storage ponds. Before final placement in the storage "ponds," paste plants remove most of the water; the paste, which begins the process at about 65 percent solids, sets up like low-grade concrete after several days.

The original ash holding ponds at Colstrip were designed with highly impermeable clay liners to prevent slurry components from seeping into the groundwater. These conformed to the requirements of the Montana Major Facility Siting Act Certificate. Monitoring wells, installed prior to the start of operations, monitor the groundwater for any sign of possible contamination (pond water seepage), and capture wells pump impacted ground water back to the ponds.

Since 2000, projects have been completed to control ash pond leakage, reduce migration of affected groundwater and to upgrade plant wastewater systems to allow increased recycling of water.

History of Ash Holding Pond Seepage. Several years after the first slurry was placed into the stage one pond for Units 1 & 2 some of the monitoring wells began to show increases in groundwater constituents, such as dissolved salts, which could indicate that some of the ash constituents were migrating through the clay lining. In consultation with MDEQ (the Montana Department of Environmental Quality), Colstrip plant operators installed capture wells to capture affected groundwater and pump it back to the ponds to prevent affected water from leaving plant property, as well as additional monitoring wells. In addition to capture wells, existing ponds have been continually modified and additional storage cells have been installed over time utilizing newer, state-of-the-art lining methods including polymer liners, geo membranes and leak detection/collection systems.

In the late 1990s, pond seepage was identified off plant property for the first time in a shallow groundwater well at the Colstrip Moose Lodge. The MDEQ was notified, a meeting was held with residents and businesses near the Moose Lodge to discuss the issue, and the plant provided a replacement well at a much greater depth.

In 2003, a group of Colstrip residents filed suit against the Colstrip owners claiming (1) homes had been damaged by settlement caused by the filling of Castle Rock Lake[2] and (2) that leakage from a Unit 1 & 2 ash pond had impacted shallow groundwater under private property. This lawsuit was settled, and although no impact to drinking water wells was identified, the plant connected the property owners with the municipal water supply as a precaution.

In 2007, two ranch owners filed a second lawsuit alleging groundwater contamination from the Units 3 & 4 effluent holding ponds. That lawsuit was also settled.

2 / Due to naturally occurring ash deposits, some of the soil in the area is susceptible to collapse when initially saturated with groundwater, such as when Castle Lake was filled to serve as the facility's water reservoir and town's drinking water supply. These 2003 claims were repeat claims of earlier lawsuits in the 1990s that also addressed construction methods (although the collapse potential was known, it was alleged that houses were not constructed with appropriate foundations, etc.).

RULES AND PROPOSED RULES

During the next five years, the Colstrip units will become subject to several recently enacted regulations, changes in existing regulations and a rule governing coal combustion residuals (CCR) published in December 2014. CCR includes fly ash, bottom ash and scrubber slurry from Colstrip.

Mercury and Air Toxics (MATS) Rule

The EPA published the final Mercury and Air Toxics Standard in February 2012 to reduce air pollution from coal and oil-fired power plants with a capacity equal to or greater than 25 megawatts. The MATS rule establishes emissions limitations at coal-fired power plants for mercury (1.2 lbs per trillion British thermal units, and for acid gases and certain toxic heavy metals using a particulate matter surrogate (0.03 lb per million British thermal units (MMBtu)). Coal-fired generating units had until April 2015 to comply with MATS, and they could receive up to a 1-year extension from state permitting authorities for the installation of controls if necessary.

On June 29, 2015, the United States Supreme Court held that the EPA failed to consider costs when deciding whether it was “appropriate and necessary” to regulate emissions of mercury and other hazardous air pollutants from power plants. The Supreme Court’s decision overturned a 2014 ruling by the U.S. Court of Appeals for the District of Columbia Circuit (“D.C. Circuit”), which held that EPA’s decision not to consider costs in the initial stages of the MATS rulemaking process was reasonable. The Supreme Court remanded the decision on MATS back to the D.C. Circuit for further proceedings, so the full impact is not yet known.

The D.C. Circuit can either remand or vacate EPA’s decision. Under a remand the MATS rule would remain in effect while EPA addresses the deficiencies outlined by the Supreme Court. If the court vacated the rule, EPA would have to start the entire rulemaking process over again. EPA and environmental groups have already signaled their intent to argue for remand. The D.C. Circuit’s decision is not expected for at least ten months, though industry petitioners may request expedited consideration.

Assuming the rule remains in effect while EPA addresses the deficiencies; plant compliance is required by April 2016. The mercury control system installed at Colstrip to meet a previous Montana mercury rule will also meet the MATS requirements for mercury capture and removal. The existing scrubbers on all four units adequately remove acid gases covered by the rule.

Some investments for additional PM control by the Unit 1 & 2 scrubbers are required to comply with the heavy metals requirements of the MATS Rule. Installation of this additional equipment (sieve trays) on Units 1 & 2 scrubbers began in the second quarter of 2014; it continued in the second quarter of 2015 and will be completed in the second quarter of 2016. Completion of this project will ensure the plant is compliant with the PM requirements of the MATS Rule. The Unit 3 & 4 scrubbers already remove the required level of PM.

See http://www.epa.gov/mats/actions.html for more information on the MATS Rule.

The Regional Haze Rule

Adopted in 1998, the Regional Haze program is a 64-year program administered by the U.S. EPA under federal law to improve visibility. Specifically the rule is aimed at improving visibility in mandatory Class I areas (National Parks, National Forests and Wilderness Areas) and is not a health-based rule. The rule requires each state to prepare an analysis of visibility impairments to Class I areas and develop plans to eliminate man-made impairment by 2064. Major sources that began construction before 1977 (including Colstrip Units 1 & 2) must bring emission controls to Best Available Retrofit Technology (BART) standards during the initial review cycle. "Reasonable Progress" requirements call for an updated analysis of impacts every five years. It requires states to constantly decrease haze in certain scenic areas of the country over time according to a "Glide Path." Power plant emissions contributing to haze are evaluated in phases every 10 years and more stringent emission controls are required as needed to stay below the Glide Path.

The EPA published its Final Implementation Plan (FIP) for Colstrip, covering both the BART and Reasonable Progress requirements in September 2012 with implementation required within five years. The first phase of the Regional Haze program set emission limits for Colstrip 1 & 2 based on various emissions control technologies to bring the haze level below the Glide Path.

There were no immediate requirements for Colstrip Units 3 & 4, but Colstrip Units 1 & 2 were determined by EPA to need to upgrade pollution controls to meet new sulfur dioxide and nitrogen oxide limits. The Sierra Club filed an appeal of the FIP with the United States Court of Appeals for the Ninth Circuit on November 15, 2012, and Talen Energy also filed an appeal as the Colstrip operator.

The case was heard on May 15, 2014 in Seattle, Washington, and the final decision by the Ninth Circuit was issued June 9, 2015. The 9th Circuit Court of Appeals reviewed EPA's first phase requirements for Colstrip and found that the EPA had not adequately justified the need for two of the control technologies and remanded these two issues back to EPA for re-do.

The ruling in no way affects the future planning periods for the Regional Haze program or the Glide Path. The current EPA assessment is that the state of Montana will require significant emission reductions to meet the natural visibility goal by 2064 which means that additional emission reductions will be necessary in future 10-year planning periods, beginning in the 2018-2028 period, and there is risk and uncertainty regarding potential costs.

For more information on the EPA FIP, see http://www2.epa.gov/sites/production/files/2014-02/documents/epafinalactononmontanaregionahazeplan.pdf.

For the draft Federal Implementation Plan containing EPA's analyses and cost estimates, see https://federalregister.gov/a/2012-8367.

Coal Combustion Residuals Rule

On April 17, 2015, the EPA published a final rule, effective October 19, 2015, that regulates coal combustion residuals (CCRs) under the Resource Conservation and Recovery Act, Subtitle D. The CCR rule addresses the risks from coal ash disposal, such as leaking of contaminants into ground water, blowing of contaminants into the air as dust, and the catastrophic failure of coal ash containment structures by establishing technical design, operation and maintenance, closure and post-closure care requirements for CCR landfills and surface impoundments, and corrective action requirements for any related leakage. The rule also sets out recordkeeping and reporting requirements including posting specific information related to CCR surface impoundments and landfills to a publicly-accessible websites. Using information from these public websites, enforcement of the CCR rule is left entirely to citizens' lawsuits – not EPA.

See http://www2.epa.gov/coalash/coal-ash-rule, and
http://www.gpo.gov/fdsys/pkg/FR-2015-04-17/pdf/2015-00257.pdf

Clean Water Act

Cooling water intake and discharge. The EPA finalized the changes to Section 316(b) of the Clean Water Act that apply to power plant standards in May 2014. The rule requires power plants to install any one of a variety of technologies to reduce the amount of fish and other aquatic life killed by cooling water intake pipes. Environmental groups filed three separate challenges to the rule on September 2, 2014. They contend that the EPA gave utilities too much flexibility in finding a way to comply. On September 4, 2014, Entergy Corporation and the Utility Water Act Group, a coalition of 191 energy companies and three utility trade associations, filed a joint challenge on behalf of utility companies. This lawsuit is still pending before the Fourth Circuit Court of Appeals.

The rule's requirements address these potential impacts:

- Existing facilities with a design intake flow of greater than 2 million gallons per day, where more than 25 percent is used for cooling, are required to select from 9 compliance options related to impingement mortality.
- Existing facilities that withdraw at least 125 million gallons per day are required to monitor entrainment and assess the costs, benefits and other adverse environmental impacts of measures for reducing entrainment mortality. Based on these reports, the regulatory agency selects the best technology available for reducing entrainment mortality at a facility.
- New units that add electrical generation capacity at an existing facility are required to install technologies that reduce impingement and entrainment to a level equivalent to closed-cycle cooling.

Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category. On September 30, 2015, the EPA finalized a rule to regulate wastewater discharges from power plants. The new rule sets limits on dissolved pollutants permitted in these discharges, and focus on mercury, selenium, and arsenic (toxic metals previously unregulated in this context).

The finalized rule applies to all steam electric power plants, except for those smaller than 50 megawatts in production capacity, and oil-fired plants. Out of approximately 1,080 steam electric power plants in the U.S., 134 are expected to require new investments in order to comply with the regulations. The regulations will take effect in 2018, and compliance will be phased in through 2023.

Along with effluent limits on toxic metals and dissolved solids, the rule establishes zero discharge limits on pollutants in ash transport water and flue gas mercury control wastewater. Many units in the Pacific Northwest will be compliant with the rule provisions with their current controls, and therefore will not incur additional compliance costs. Colstrip is a Zero Liquid Discharge (ZLD) facility, so it will not be affected by the rule.

The Clean Air Act

National Ambient Air Quality Standards (NAAQS). Two types of national air quality standards are established by the Clean Air Act. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation and buildings. These ambient level standards apply uniformly throughout the states. The Clean Air Act required EPA to set NAAQS for widespread pollutants from numerous and diverse sources considered harmful to public health and the environment. EPA has set NAAQS for six "criteria" pollutants; periodic review of the standards and the science on which they are based is required. Each time the NAAQS are revised, the states must evaluate whether any parts of the state exceed the standard (these are “non-attainment” areas). If a state contains any non-attainment areas, it must propose a plan and schedule to reduce emissions in order to achieve attainment approval by the EPA. Currently the Colstrip area of Montana is in attainment for all criteria pollutants. Reductions in Colstrip emissions for SO_2, NO_X and PM to meet the MATS Rule and the EPA FIP are expected to keep the area in attainment with any NAAQS revisions with no further actions required. For more information, go to http://www.epa.gov/ttn/naaqs/criteria.html.

Section 111(d) of the Clean Air Act. EPA issued a final 111(d) rule on August 3, 2015 which included several changes, many of which were requested in PSE’s comments. Specifically, EPA excluded energy efficiency from the building blocks, leaving just three building blocks (increased efficiency for coal plants, greater utilization of natural gas plants and increased renewable sources), and provided more flexibility on interim goals by phasing in the reduction of the second building block and giving states the option to set their own interim compliance glide path and pushing the start of compliance to 2022. EPA also adjusted the 2012 baseline to address hydroelectricity variability and provided specific CO_2 mass targets by year for each state.

States have broad flexibility to pick a rate-based or mass-based approach and can design compliance options and decide how to allocate credits and whether to allow trading.

EPA also gave states the option of seeking an additional time if necessary to formulate a state plan---states must submit something within one year but can request up to an additional two years for development of a state plan.

Based on the changes to the final rule, the final CO_2 goal for Montana became 26 percent more stringent and the final CO_2 goal for Washington became 35 percent less stringent. By 2030 Montana must reduce CO_2 emissions from coal plants from 20.5 million tons of CO_2 to 11.3 million tons of CO_2 which is a 45 percent reduction in CO2 emissions. How this will affect Colstrip cannot be determined until a state implementation plan for Montana is finalized and approved by EPA.

ELECTRIC ENERGY STORAGE

Contents

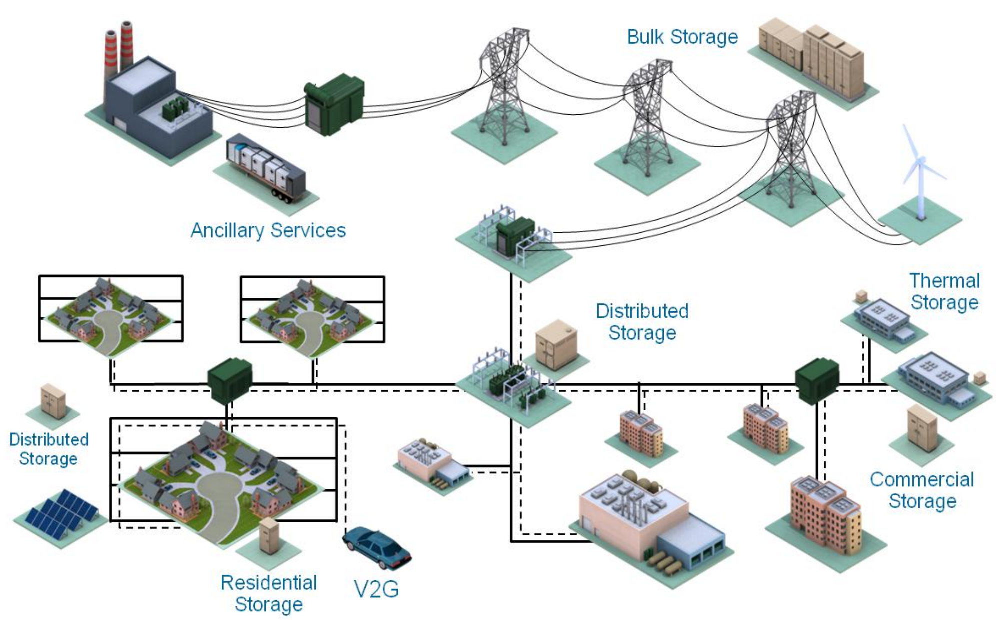
The electric energy storage industry has made significant progress in recent years. This year, for the first time, PSE models two types of storage technology in the IRP analysis: lithium-ion batteries and pumped hydro. In addition, the company is developing a pilot project to test the benefits of battery storage to both the generation and the transmission and distribution functions of the company. This appendix delivers an overview of energy storage technologies, the services they can provide and key development considerations. It presents the assumptions and methodology of our energy storage flexibility analysis, and it describes PSE's pilot project.

OVERVIEW

Electric energy storage (also simply called “energy storage”) encompasses a wide range of technologies that are capable of shifting energy usage from one time period to another. These technologies could deliver important benefits to electric utilities and their customers, since the electric system currently operates on “just-in-time” delivery. Generation and load must be perfectly balanced at all times to ensure power quality and reliability. Strategically placed energy storage resources have the potential to increase efficiency and reliability, to balance supply and demand, to provide backup power when primary sources are interrupted and to assist with the integration of intermittent renewable generation. Energy storage is capable of benefiting all parts of the system – generation, transmission and distribution – as well as customers (see Figure L-1).

Throughout this appendix, energy storage resources will be described in terms of their nameplate power rating and their energy storage capacity. For example, a 10 MW/20 MWh storage system is capable of delivering 10 megawatts of AC power for two hours, for a total of 20 megawatt-hours of energy delivered to the grid (10MW x 2 hours = 20 MWhs). Systems can be as large as pumped hydropower facilities that provide hundreds of megawatts of power for many hours or as small as off-grid battery systems that support electric service for small, remote residences and facilities. This flexibility is one of its attractive qualities.

Figure L-1: Overview of Energy Storage Roles on the Electric Grid



Source: EPRI

Recent Industry Developments

The energy storage industry has made significant progress since PSE's last IRP. Among the most notable developments are the following.

- The U.S. installed 61.9 MW of battery energy storage resources in 2014, up 40 percent from 2013, and 180 individual installations were completed. 2015 is expected to be the biggest year in the market's history with 220 MW of deployments, twice the capacity installed in 2013 and 2014 combined.[1]
- Southern California Edison (SCE) procured 250 MW of storage, more than 5 times the requirement mandated by the California Public Utilities Commission (CPUC) Storage Decision.[2] SCE's technology picks ranged from distributed batteries and ice-making air conditioners to the world's largest proposed lithium-ion battery (100 MW/400 MWh). Many of these systems won't be built for several years, but SCE expects that they "will contribute towards grid optimization, greenhouse gas reduction or renewable integration," according to testimony before CPUC.[3]
- Hawaiian Electric Co. launched one of the biggest energy storage requests for proposals for "one or more large-scale energy storage systems able to store 60 to 200 megawatts for up to 30 minutes." The utility seeks at least 60 MW, potentially spread among several separate projects, to help integrate renewable resources, improve reliability and provide auxiliary services to help operate the grid, such as sub-second frequency response and minute-to-minute load following.[4]

1 / GTM Research, U.S. Energy Storage Monitor, 2014 Year in Review. The estimated 220 MW of deployments represents residential, non-residential and utility solar installations in 2015.
2 / California D. 13-10-040 ("the Storage Decision"). In October 2013, the CPUC adopted an energy storage procurement framework and established an energy storage target of 1,325 megawatts for PG&E, Southern California Edison and SDG&E by 2020, with installations required no later than the end of 2024.
3 / Southern California Edison testimony filed with California Public Utilities Commission in support of 2014 Energy Storage Application, 2/28/2014. Retrieved from https://scees.accionpower.com/_scees_1401/documents.asp?strFolder=d. SCE Regulatory Filings/&filedown=&HideFiles=True.
4 / Hawaiian Electric Company web site. "Hawaiian electric close to selecting energy storage providers for Oahu," 9/29/2014. Retrieved from http://www.hawaiianelectric.com/heco/_hidden_Hidden/CorpComm/Hawaiian-Electric-close-to-selecting-energy-storage-providers-for-Oahu?cpsextcurrchannel=1.

- Pacific Gas & Electric (PG&E) issued a request for offers (RFO) in December 2014, pursuant to the CPUC Storage Decision, for up to 74 MW of energy storage resources. Up to 50 MW would be transmission-connected and 24 MW would be distribution-connected. Expected benefits include grid optimization, renewable resource integration and/or a reduction in greenhouse gas emissions. Optimization benefits could include peak reduction, contribution to reliability needs, or deferral of transmission and distribution investments.[5] In its RFO, PG&E stated that the company is soliciting new energy storage systems that would enable it "to defer otherwise necessary investments at up to 5 distribution substations."[6]
- New York regulators approved Con Edison's proposed plan to defer $1 billion in substation upgrades with 52 MW of nontraditional customer- and utility-side solutions by 2018. The program allows Con Edison (ConEd) to procure market-based distributed energy resource solutions like energy efficiency, energy storage, distributed generation and demand-response to reduce load on specific feeders. In February 2014, ConEd introduced a demand management program that includes incentives of $2,100 per kW for battery storage systems sited on customer premises that charge during off-peak hours and discharge during peak periods.
- Oncor released a report concluding that the Electric Reliability Council of Texas (ERCOT) would see net benefits of up to 5 gigawatts from "grid-integrated, distributed electricity storage" if battery prices fall to $350 per kWh. The analysis assumes the capture of as much benefit as possible by integrating the value from increased customer reliability, improved T&D systems and wholesale power market transactions. As a transmission and distribution utility, Oncor is not allowed to put generation assets into its rate base. This report and the legislative efforts it provokes may challenge the conventional separation of transmission and distribution (T&D) from generation.
- Tesla broke ground on its $5 billion "gigafactory" setting the stage to potentially double global production of lithium-ion batteries by approximately 2020. Most of the output will go to electric vehicles (EVs), but about 15 GWh per year is expected to reach the power grid market. Asian competitors (or partners) like Panasonic, LG Chem, NEC/A123 and a host of Chinese contenders continue pushing the volume of lithium-ion battery manufacturing up and costs down.

5 / PG&E web site, 2014 Energy Storage RFO, "Protocol," page 12, 1/27/15. Retrieved from http://www.pge.com/en/b2b/energysupply/wholesaleelectricsuppliersolicitation/RFO/ES_RFO2014/index.page.
6 / PG&E web site, 2014 Energy Storage RFO, "Appendix E1 - Information for PSA, Distribution Deferral ES," page 1. Retrieved from http://www.pge.com/en/b2b/energysupply/wholesaleelectricsuppliersolicitation/RFO/ES_RFO2014/index.page (1/27/15).

- Snohomish PUD energized the first grid-scale battery system in Washington in late 2014. The 0.5 MW lithium-ion system is located in the Hardeson Substation in Everett. It will serve as a testing ground for developing the Modular Energy Storage Architecture (MESA) standards, as well as for improving reliability and integrating renewable energy. Performance testing and use case analysis began in early 2015.
- Avista deployed a 1 MW battery system at the Schweitzer Engineering Labs (SEL) factory site. Commissioning was completed in June 2015. The goal is to demonstrate providing backup power (outage mitigation), microgrid operation, peaking capacity, grid flexibility, volt/VAR control, and to demonstrate voltage regulation as part of a conservation voltage reduction scheme.[7]
- Some notable failures also took place. Several battery storage companies and integrators went into bankruptcy; however, many reemerged after being purchased by other companies or reorganized. The industry is still young, and it has many nascent players with technologies and business models that are in various stages of development.
- MESA, the Modular Energy Storage Architecture standards group of which PSE is a founding member, launched in October 2014. MESA has proposed a draft specification for communication protocols between energy storage components. Underwriters Laboratories (UL) has also proposed a set of standards for grid electric storage, and work continues on integrating storage with smart inverters for grid management.

7 / Avista 2015 Electric Integrated Resource Plan Technical Advisory Committee Meeting No. 1 Presentation

POTENTIAL ELECTRICITY STORAGE SERVICES

Terminology and definitions for the grid services that energy storage may provide are not yet uniform, but the 2013 U.S. Department of Energy DOE/EPRI Electricity Storage Handbook provides the following list (Figure L-2).

Figure L-2: Energy Storage Grid Services

Bulk Energy Services		**Transmission Infrastructure Services**
Electric Energy Time-shift (Arbitrage)		Transmission Upgrade Deferral
Electric Supply Capacity		Transmission Congestion Relief
Avoided Renewable Curtailment		
Ancillary Services		**Distribution Infrastructure Services**
Regulation		Distribution Upgrade Deferral
Spinning, Non-spinning and Supplemental Reserves		Voltage Support
Voltage Support		Outage Mitigation
Black Start		**Customer Energy Management Services**
		Power Quality
		Power Reliability
		Retail Electric Energy Time-shift
		Demand Charge Management

Source: DOE/EPRI Electricity Storage Handbook in Collaboration with NRECA

These applications, how they relate to PSE and some of the potential challenges to adoption are described below. It is important to note that not all of the services described below have been demonstrated in commercial or utility settings. The ability of a single storage resource to provide these services depends on many factors, among them:

1. minimum required energy storage power (MW) and energy (MWh),
2. location requirements,
3. availability requirements (both frequency and duration), and
4. system performance characteristics (response time, ramp rate, etc.).

Moreover, using storage to provide multiple grid services can be complicated, since use for some services can exclude use for other services. For example, an energy storage system that provides transmission reliability service must reserve its storage capacity for contingency needs during certain time periods, rendering it unavailable for other uses during those periods. Detailed modeling is required to evaluate storage resources intended for multiple uses.

Bulk Energy Services. The term "bulk energy services" refers to all of the ways that energy storage is used to avoid the need to generate additional electricity.

ELECTRIC ENERGY TIME-SHIFT (ARBITRAGE). In this application, storage resources stockpile energy for later use, typically charging when the cost of electricity is low and discharging when the cost of electricity is high.

ELECTRIC SUPPLY CAPACITY. In this application, storage resources serve as generation supply capacity resources, similar to peaking plants. Historically, peak load demands – rather than economic conditions – have driven decisions on when to build new power plants. If energy storage can provide reliable peaking capacity, it may enable utilities to postpone or eliminate the need for new peaking power plants. PSE also refers to this service as "Energy Supply Capacity Value."

AVOIDED RENEWABLE CURTAILMENT. When renewable resources like wind continue to produce power even when there is no demand for it, energy storage can store this energy for release when it's needed. In addition to time-shifting, this enables utilities to avoid renewables curtailments that result in the loss of production tax credits (PTCs) and renewable energy credits (RECs).

Ancillary Services. Ancillary services are defined as "those services necessary to support the transmission of electric power from seller to purchaser given the obligations of control areas and transmitting utilities within those control areas to maintain reliable operations of the interconnected transmission system."[8] In other words, these services support the reliable delivery of power and energy over the high voltage transmission system.

REGULATION (OR FREQUENCY REGULATION). Regulation ensures the balance of electricity supply and demand at all times, particularly over short time frames (from seconds to minutes). Because energy storage can both charge and discharge power, it can help manage grid frequency. Many storage technologies can do this faster and more accurately than other regulating resources. Federal Energy Regulatory Commission (FERC) Order 755 requires that ISOs implement mechanisms to pay for regulation resources based on how responsive they are to control signals. Under the new rules, storage resources with high-speed ramping capabilities receive greater financial compensation than slower storage or conventional resources.

8 / U.S. Federal Energy Regulatory Commission 1995, Promoting Wholesale Competition Through Open Access Non-discriminatory Transmission Services by Public Utilities, Docket RM95-8-000, Washington, DC, March 29.

SPINNING RESERVES, NON-SPINNING RESERVES, AND SUPPLEMENTAL RESERVES. Generation capacity over and above customer demand is reserved for use in the event of contingency events like unplanned outages. “Spinning” reserves are generators that are turned on, idling, waiting for the signal to go. Many storage technologies can be synchronized to grid frequency through their power electronics, so they can provide a service equivalent to spinning reserves with minimal to zero standby losses (unlike the idling generators). Energy storage is also capable of providing non-spinning or supplemental reserves, but these services are easier for traditional generators to accomplish cost-effectively.

VOLTAGE SUPPORT. This ancillary service is used to maintain transmission voltage within an acceptable range. Advanced power electronics give storage resources with four-quadrant inverters the capability to inject VARs and correct suboptimal or excessive voltage; however, a number of other devices are capable of providing voltage support at low cost, so the value of this service for energy storage is considered to be low.

BLACK START. This service, typically provided by generators, restores the electric grid following a blackout. While energy storage could theoretically provide this service, black start is of minimal value to PSE, because of its many other low-cost, black start-capable generation resources.

PSE’s Open Access Transmission Tariff illustrates the relative cost for PSE to provide ancillary services:

Figure L-3: PSE Open Access Transmission Tariff

Service	Rate ($/kW-yr)
Reactive Supply and Voltage Control	$0.07533
Regulation and Frequency Response	$126.00
Operating Reserve – Spinning	$111.00
Operating Reserve – Supplemental	$108.00

Transmission Infrastructure Services. These services relate to reliability and economics; they enable the electric transmission system to operate more optimally and efficiently.

TRANSMISSION INVESTMENT DEFERRAL. When a generation resource like energy storage or demand-side resources can cost-effectively defer capital expenditure in the transmission system, it's called "transmission investment deferral." Transmission resources are sized to handle peak capacity during normal operation with all elements in service, but it must be designed to meet capacity requirements even when portions of the network are out of service. It is possible to use energy storage to address capacity constraints created by periods of peak demand or specific contingencies; however, this is difficult due to the networked nature of the transmission system and storage specifications such as location, sizing, regulatory requirements and system controls. Also, deferring investment in transmission capacity projects is not always the best solution, since these projects usually increase system reliability and this is a valuable benefit. Radial transmission lines, where the battery could provide backup power, are a major exception.

TRANSMISSION CONGESTION RELIEF. This refers to using storage resources in a geographic area where locational marginal price *(LMP)* is jointly defined by the wholesale market price of energy and the amount of location-specific congestion in the electric system. The storage resource would optimize its dispatch based on an hourly LMP price signal. Since the Pacific Northwest does not use locational marginal pricing, it was not modeled in this analysis.

Distribution Infrastructure Services. These services support the physical infrastructure of the distribution system that connects distribution substations to customer meters.

DISTRIBUTION INVESTMENT DEFERRAL. This is similar to transmission investment deferral, but specific to the distribution system. To relieve overloaded distribution transformers, particularly high-cost substation transformers, energy storage can charge during low load periods and “peak shave” the highest load periods. This may postpone the need for a distribution investment. However, an energy storage system may be limited in its ability to deliver the operational flexibility and reliability improvements that traditional distribution infrastructure provides. For example, using storage to defer a new substation may make it harder to take existing substations offline for maintenance or in response to unplanned outages. For each candidate system, the tradeoffs between reliability, operational flexibility, capacity and cost need to be studied.

DISTRIBUTION VOLTAGE SUPPORT. This service maintains power voltage within acceptable bounds, as defined by ANSI standards (+/- 5 percent of nominal). A storage system could provide voltage support on distribution lines and support a conservation voltage reduction scheme, but the value of this service for energy storage is considered low, because other devices are capable of providing low-cost voltage support.

OUTAGE MITIGATION. When properly designed for this capability, storage resources can provide backup power to the distribution system for a limited time during some outages. For example, if a distribution line had a planned or unplanned outage and a storage resource on the load side of that outage was available for discharge, customers could continue to have electric service during the first few hours of an outage. Complex technical issues need to be addressed and solved regarding the stability, power flow, protection and operation of the “islanded” system, especially as the storage capacity grows.

Customer Energy Management. Although not a part of this study, storage resources placed on the customer side of the meter can also provide direct benefits to customers, such as increased power quality, reliability, the ability to shift consumption to hours with lower energy rates and demand charges.

ENERGY STORAGE TECHNOLOGIES

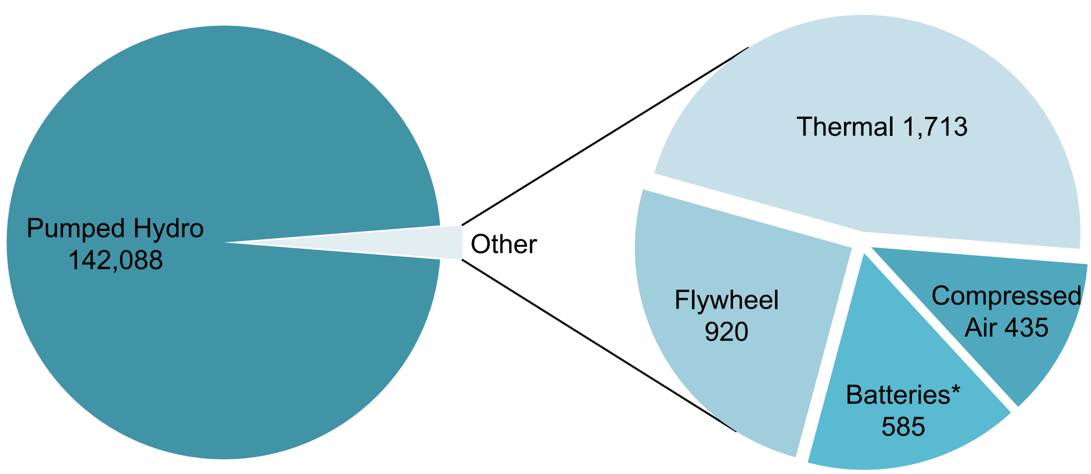
Energy storage encompasses a wide range of technologies and resource capabilities, and these differ in terms of cycle life, system life, efficiency, size and other characteristics.

Figure L-4: Energy Storage Technology Classes

Technology Class	Examples
Chemical Storage	Batteries
Mechanical Storage	Flywheels, Compressed Air
Thermal Storage	Ice, Molten Salt, Hot Water
Bulk Gravitational Storage	Pumped Hydropower, Gravel

Although battery technology has attracted a great deal of industry attention in recent years, pumped hydro technology still supplies the vast majority of grid-connected energy storage (97.5 percent). The remaining categories combined comprise only 2.5 percent of installed capacity, as the chart below illustrates.

Figure L-5: Installed Grid-connected Energy Storage in MW, by Technology, as of 8/2015[9]



*Batteries include Lithium-ion, Flow, Sodium Sulfur, Nickel Cadmium, Lead Acid, Electrochemical Capacitors and Ultracapacitor Batteries

9 / Source: U.S. Department of Energy Global Energy Storage Database (DOE GESDB), August 2015 (http://www.energystorageexchange.org)

Chemical Storage (Batteries)

This class of energy storage includes the following chemistries: advanced lead acid, lithium-ion, sodium-based, nickel-based, flow batteries and electrochemical capacitors. Technologies are further divided into sub-categories based on the specific chemical composition of the main components (anode, cathode, separator, electrolyte, etc.). Each class and sub-category is at a different stage of commercial maturity and has unique power and energy characteristics that make it more or less appropriate for specific grid support applications.

Advanced Lead Acid. Invented in the 19th century, lead acid batteries are the most fully developed and commercially mature type of rechargeable battery. They are widely used in both mobile applications like cars and boats and stationary consumer applications like UPS units and off-grid PV. However, several issues have prevented widespread adoption for utility-scale grid applications. These include short cycle life, slow charging rates and high maintenance requirements.[10] The DOE Energy Storage Database identifies 13 operational projects that have a power rating greater than 1 MW. These perform a variety of services including peak shaving, on-site power, ancillary services, ramping and renewables capacity firming.

Technical Details: Lead acid batteries rely on a positive, lead-dioxide electrode reacting with a negative, metallic lead electrode through a sulfuric acid electrolyte. Ongoing research and development have produced several proprietary technologies in two categories: advanced lead acid and lead acid carbon.

Advanced lead acid batteries incorporate a variety of technological enhancements. Companies such as GS Yuasa and Hitachi are improving system response times with incremental technology enhancements like valve-regulation, solid state electrolyte-electrode configurations and anode electrodes that include capacitors.[11]

While technologically distinct, lead acid carbon is considered a type of advanced lead acid battery.[12] Lead acid carbon batteries add carbon to one or both electrodes. This addresses two major barriers that have limited adoption of lead acid technology: 1) a tendency for sulfate to accumulate on the negative electrode surface which leads to large decreases in capacity and cycle life, and 2) slow charge/discharge rates. Adding carbon reduces sulfate accumulation and allows faster charge and discharge with no apparent detrimental effects.[13]

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10 / Navigant (2012)
11 / DOE-EPRI 2013 Energy Storage Handbook
12 / DOE-EPRI 2013 Energy Storage Handbook
13 / DOE-EPRI 2013 Energy Storage Handbook

Research and development by Xtreme Power (now Younicos), Axion Power and Ecoult/East Penn has led to several utility-scale deployments ranging from 1 MW to 36 MW.[14] Improvements in maintenance requirements, cycle life and charging rates are allowing lead acid carbon systems to perform a variety of grid services that were not economic with standard lead acid batteries.

Downsides to lead acid technology include its low power and energy density compared to other batteries, limited life ranges of approximately 6 to 15 years, and toxic lead electrodes and sulfur electrolytes which require special handling and recycling.[15]

Deployments: Deployments total 88 MW/79 MWh in 44 projects. Capacities range from 2 kW/10 kWh to 36 MW/24 MWh. Figure L-6 describes the five largest installations.

Figure L-6: Five Largest Operational Lead Acid Energy Storage Projects[16]

Five Largest Operational Lead Acid Energy Storage Projects, by Energy Rating				
Owner / Project	**Power / Energy (Duration)**	**Technology**	**Location**	**Primary Function**
Duke Energy / Notrees	36 MW / 24 MWh (40 minute)	Advanced lead acid	Goldsmith, TX	Renewables capacity firming
Kuroshio Power / Shiura Wind Park	4.5 MW / 10.5 MWh (2.3 hour)	Valve regulated lead acid	Aomori, Japan	Renewables capacity firming
Shonai Wind Power Generation Co. / Yuza Wind Farm Battery	4.5 MW / 10.5 MWh (2.3 hour)	Valve regulated lead acid	Yamagata, Japan	Renewables capacity firming
First Wind LLC / Kaheawa Wind Project II	10 MW / 7.5 MWh (45 minute)	Advanced lead acid	Maalaea, HI	Renewables capacity firming
GridSolar Boothbay Pilot Project: BESS	0.5 MW / 3 MWh (6 hour)	Valve regulated lead acid	Boothbay, ME	Energy time shift, supply capacity

Lead acid deployments of 11 MW/13 MWh are either planned or under construction. Nine MW of these are from 3 projects.[17]

14 / CELA, Sandia (2012)
15 / IEC (2011)
16 / DOE GESDB (2015)
17 / DOE GESDB (2015)

Lithium-ion. First commercialized in 1991, lithium-ion batteries have experienced tremendous research and development investment and publicity in the last few years due to their high energy density, voltage ratings, cycle life and efficiency. They have been the preferred battery technology for portable electronic devices and electric vehicles, and now they are being scaled up and deployed for utility grid services. Approximately 70 systems with power ratings of 1 MW or greater are currently in operation around the world. Because it can adapt to a range of power and energy ratings, this technology can perform a wide variety of services. Grid-scale units range from small, regulation pilot projects of 1 MW/0.5 MWh (30 minute duration) to large 8 MW/32 MWh (4 hour duration) and 32 MW/8 MWh (15 minute duration) systems that perform ramp control and wind and solar integration.[18]

Technical Details: Lithium-ion is a broad technology class that includes many sub-types. Sub-type classifications generally refer to the cathode material.[19] Some common chemistries are compared in Figure L-7.

Figure L-7: Comparison of Lithium-ion Chemistries[20]

Chemistry (Shorthand)	Safety	Energy	Power	Life	Cost	Summary
	Scale 1-5 with 5 Best					
Lithium Manganese Oxide (LMO)	3	4	3	3	4	Versatile technology with good overall performance & cost
Lithium Iron Phosphate (LFP)	3	3	4	4	3	Similar to LMO, but slightly more power & less energy
Lithium Nickel Cobalt Aluminum (NCA)	1	3	4	4	2	Good for power applications; poor safety & high cost per kWh
Lithium Titanate (LTO)	5	2	5	5	2	Excellent power & cycle life; high cost per kWh
Lithium Nickel Manganese Cobalt (NMC)	3	4	4	4	4	Versatile technology with good overall performance & cost

Lithium-ion technologies are also divided by cell shape: cylindrical, prismatic or laminate. Cylindrical cells have high potential capacity, lower cost and good structural strength. Prismatic cells have a smaller footprint, so they are used when space is limited (as in mobile phones). Laminate cells are flexible and safer than the other shapes.[21]

18 / DOE GESDB (2015)
19 / Yoshio et al. (2009)
20 / Hardin (2014)
21 / Citi (2012)

Lithium-ion battery advantages include high energy density, high power, high efficiency, low self-discharge, lack of cell "memory" and fast response time; challenges include short cycle life, high cost, heat management issues, flammability and narrow operating temperatures.[22]

Deployments: Approximately 312 MW/333 MWh of lithium-ion projects are currently in operation, and - more than 70 projects have power ratings of 1 MW or larger. These utility-scale systems can be separated into two categories: high power, short duration projects that perform frequency regulation and high energy projects that help to integrate intermittent renewable generation.

Figure L-8: Five Largest Operational Lithium-ion Energy Storage Projects[23]

Five Largest Operational Lithium-ion Energy Storage Projects, by Energy Rating				
Owner / Project	**Power / Energy (Duration)**	**Technology**	**Location**	**Primary Function**
State Grid Corporation of China / Zhangbei National Wind and Solar Energy Storage and Transmission Project	6 MW / 36 MWh (6 hour)	Lithium-ion-phosphate	Hebei, China	Renewable generation shifting
Southern California Edison / Tehachapi Wind Energy Storage Project	8 MW / 32 MWh (4 hour)	Lithium-ion	Tehachapi, CA	Renewable generation shifting
State Grid Corporation of China / Zhangbei National Wind and Solar Energy Storage and Transmission Project	4 MW / 16 MWh (4 hour)	Lithium-ion-phosphate	Hebei, China	Renewable generation shifting
Hawaii Renewable Partners / Hawi Wind Farm BESS	1 MW / 15 MWh (15 hour)	Lithium-ion	Hawaii	Renewables capacity firming
Invenergy / Grand Ridge Energy Storage	31.5 MW / 12.08 MWh (23 minute)	Lithium-ion-phosphate	Marseilles, IL	Frequency regulation

There are more than 45 lithium-ion projects with anticipated power ratings greater than 1 MW either planned or under construction, totaling 355 MW.[24]

22 / *PNNL (2012)*
23 / *DOE GESDB (2015)*
24 / *DOE GESDB (2015)*

Sodium Sulfur. Sodium sulfur (NaS) battery technology was invented by Ford Motors in the 1960s, but research, development and deployment by Japanese companies like NGK Insulators and Tokyo Electric Power Company over the past 25 years have established NaS as a commercially viable technology for fixed, grid-connected applications. Commercially deployed systems in the 400 kW to 34 MW power rating range (and system duration of roughly 6 hours) provide numerous high-energy grid support applications.[25]

Technical Details: Sodium sulfur batteries use a positive electrode of molten sulfur, a negative electrode of molten sodium and a solid beta alumina ceramic electrolyte that separates the electrodes. Batteries require charge/discharge operating temperatures between 300-350°C, so each unit has a built in heating element. High operating temperatures and hazardous materials require the systems to include safety features like fused electrical isolation, hermetically-sealed cells, sand surrounding cells to mitigate fire and a battery management system that monitors cell block voltages and temperatures. Typical units are composed of 50 kW modules that are available in multiples of 1 MW/~6 MWh (approximately 6 hour duration). Units are combined in parallel to create large-scale systems, typically between 2 and 10 MW.[26]

The advantages of sodium sulfur are its high power and long duration, extensive deployment history and commercial maturity. Downsides include risk of fire, round-trip efficiencies of 70 percent to 90 percent, and potentially high self-discharge/parasitic load values of 0.05 percent to 20 percent due to the internal heating requirements.[27] NaS is much less efficient for infrequent cycling applications because the internal heating element continually consumes energy.

Deployments: To date about 98.1 MW/640 MWh of sodium sulfur technology is deployed at approximately 26 sites globally, with systems ranging in size from 400 kW to 34 MW. Most installations are in Japan, but 10 systems have been commissioned in the U.S. in the past 10 years. Peak shifting is the most frequent application, but specified services include renewables capacity firming, transmission and distribution upgrade deferral, frequency regulation and electric supply reserve capacity.

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25 / *DOE-EPRI 2013 Energy Storage Handbook*
26 / *DOE-EPRI 2013 Energy Storage Handbook*
27 / *SBC Energy Institute (2013)*

Figure L-9: Five Largest Operational Sodium Sulfur Energy Storage Projects[28]

Five Largest Operational Sodium Sulfur Energy Storage Projects				
Owner / Project	**Power / Energy (Duration)**	**Technology**	**Location**	**Primary Function**
Japan Wind Development / Rokkasho Village Wind Farm	34 MW / 238 MWh (7 hour)	Sodium sulfur	Rokkasho Village, Japan	Renewable generation shifting
Tokyo Metropolitan Government / Morigasaki Water Reclamation Center	8 MW / 58 MWh (7.25 hour)	Sodium sulfur	Tokyo, Japan	Load leveling
Hitachi / Automotive Plant ESS	9.6 MW / 57.6 MWh (6 hour)	Sodium sulfur	Ibaraki, Japan	Load leveling
Abu Dhabi Water & Electricity Authority / BESS	8 MW / 48 MWh (6 hour)	Sodium sulfur	Abu Dhabi, United Arab Emirates	Load leveling
American Electric Power / Presidio ESS	4 MW / 32 MWh (8 hour)	Sodium sulfur	Presidio, TX	Ancillary services

The DOE Global Energy Storage Database lists three deployments that are planned or under construction. All three are for Italian utility TERNA and they total 35 MW/278 MWh.

Sodium Nickel Chloride. Sodium nickel chloride batteries ($NaNiCl_2$) are also referred to as ZEBRA (Zero Emissions Battery Research). Their operating characteristics are similar to those of sodium sulfur, but this technology is still in a demonstration and limited deployment stage. GE and FIAMM have currently deployed about 15 installations with power ratings that range from 20 kW/70 kWh (3.5 hour duration) to 1 MW/2 MWh (2 hour duration). These systems are used primarily for integrating renewable generation, providing voltage support, load following and frequency regulation.

Technical Details: In sodium nickel chloride batteries, the cathode is composed of nickel-chloride instead of sulfur. These require operating temperatures between 260°C and 350°C and therefore must have internal thermal management capability. Able to withstand limited overcharging, they are potentially safer than sodium sulfur, and they have a higher cell voltage. Typical cells are 20 kWh, so system power and energy ratings are also easier to customize to a given application than sodium sulfur.[29]

28 / DOE GESDB (2015)
29 / IEC (2011)

Sodium nickel chloride advantages include scalability, the ability to operate in a wide temperature range (-40°C to 60°C),[30] long cycle life, and easy recycling of battery materials.[31] Disadvantages include lack of maturity, commercial deployments, high cost and thermal management.[32]

Deployments: Approximately 3.4 MW/6.4 MWh of sodium nickel chloride installations are operating around the world.[33]

Figure L-10: Five Largest Operational Sodium Nickel Chloride Energy Storage Projects[34]

Five Largest Operational Sodium Nickel Chloride Energy Storage Projects				
Owner / Project	**Power / Energy (Duration)**	**Technology**	**Location**	**Primary Function**
Wind Energy Institute of Canada / Durathon Battery	1 MW / 2 MWh (2 hour)	Sodium nickel chloride	Prince Edward Island, Canada	Renewable generation shifting
General Electric / Wind Durathon Battery Project	0.3 MW / 1.2 MWh (4 hour)	Sodium nickel chloride	Tehachapi, TX	Renewable generation shifting
PDE Inc. / 29 Palms Durathon Battery Project	0.5 MW / 1 MWh (2 hour)	Sodium nickel chloride	Palm Springs, CA	Microgrid
Western Power Distribution / Falcon Project	0.25 MW / 0.5 MWh (2 hour)	Sodium nickel chloride	Milton Keynes, United Kingdom	T&D upgrade deferral
Duke Energy / Rankin Substation ESS	0.4 MW / 0.3 MWh (42 minutes)	Sodium nickel chloride	Mount Holly, NC	Renewable capacity firming

A half dozen deployments are planned or under construction in the United States, Italy and the Maldives.[35] While most of these systems are planned to be rated at 100 kW to 400 kW, two Italian installations are planned to be rated at 1 MW and 4 MW.

30 / GE Website (2014)
31 / EUROBAT Website (2014)
32 / V. Antonucci (2012)
33 / DOE GESDB (2015)
34 / DOE GESDB (2015)
35 / DOE GESDB (2015)

Nickel-based. The two main sub-technologies in the nickel-based family are nickel cadmium (NiCd), which has been in commercial use since 1915, and nickel metal hydride (NiMH), which became available around 1995. Nickel-based batteries are primarily used in portable electronics and electric vehicles due to their high power density, cycle life and round-trip efficiency. Only two operational projects have energy ratings greater than 1 MWh. One of them provides electric supply reserve capacity in Alaska, and the other performs renewable capacity firming on Bonaire Island. Although Sandia states that "Nickel-cadmium and nickel metal hydride batteries are mature and suitable for niche applications,"[36] the fact that so few grid-scale deployments exist suggests that nickel-based technology is not yet competitive with other battery types.

Technical Details: All nickel-based batteries employ a cathode of nickel hydroxide. Sub-categories are classified by anode composition: nickel cadmium, nickel iron, nickel zinc, nickel hydrogen and nickel metal hydride. The first three use a metallic anode; the last two have anodes that store hydrogen.

Nickel cadmium chemistry is a low-cost, mature technology with high energy density, but the toxicity of cadmium necessitated a search for alternatives. Nickel metal hydride was developed in response. The metal hydride chemistry is safer and has a higher specific energy than nickel cadmium, but it charges slower and does not withstand very low operating temperatures.[37] Nickel metal hydride's safety made it the battery of choice for electric and hybrid vehicles, but lithium-ion is challenging this status. Other nickel chemistries are in the research and development phase.

Deployments: Deployments of nickel-based batteries total 30.4 MW/7.9 MWh, of which 27MW/6.8MWh is installed in one project. Figure L-11 shows the three largest nickel-based energy storage projects on the DOE Global Energy Storage Database that are not owned by private citizens.

36 / DOE-EPRI 2013 Energy Storage Handbook: p109
37 / Linden (2001)

Figure L-11: Three Largest Nickel-based Energy Storage Projects[38]

Three Largest Operational Nickel-based Energy Storage Projects				
Owner / Project	**Power / Energy (Duration)**	**Technology**	**Location**	**Primary Function**
Golden Valley Electric Association / Battery Energy Storage System	27 MW / 6.75 MWh (15 minutes)	Nickel cadmium	Fairbanks, AK	Electric Supply Reserve - Spinning
EcoPower Bonaire BV / Bonaire Wind-Diesel Hybrid	3 MW / 0.25 MWh (5 minutes)	Nickel cadmium	Bonaire, Netherlands	Renewables capacity firming
Okinawa Electric Power Company / Minami Daito Island	0.3 MW / 0.08 MWh (15 minutes)	Nickel metal hydride	Okinawa, Japan	Frequency regulation

According to the DOE Global Energy Storage Database, there are no megawatt scale nickel-based projects currently planned or under construction.

Flow Batteries. Flow batteries are fundamentally different than other types of electrochemical storage because the systems' power and energy components are separate. This feature allows flow systems to be tailored to specific applications and constraints. A number of megawatt-scale demonstration projects are testing the deep discharge ability, long cycle life and easy scalability that characterize flow batteries. Some chemistries have been more extensively developed and deployed than others; maturity ranges from development stage (for iron-chromium and zinc-bromine) to pre-commercial (for vanadium). Projects in operation range from 5 MW/10 MWh (2 hour duration) to 3 kW/8 kWh (2 hour, 40 minute duration). The larger projects are focused on integrating renewables, while many of the smaller pilots are testing for peak shaving and ancillary services as well.[39]

Technical Details: One or both of a flow battery's active materials is in solution in the electrolyte at any given time. In traditional flow batteries, the electrolyte solution is stored in separate containers and pumped to the cell stack and electrodes where an oxidation-reduction reaction occurs. This allows the electrolyte tanks (energy) and cell stack (power) to be sized separately, which makes these systems very flexible.[40]

38 / DOE GESDB (2015)
39 / DOE-EPRI 2013 Energy Storage Handbook
40 / Gyuk/ESTAP (2014)

Several chemistries have proven technically feasible, including vanadium-vanadium (V^{n+}), iron-chromium (Fe-Cr) and zinc-bromine ($ZnBr_2$). Iron-chromium's advantages are a very safe electrolyte and abundant and low-cost materials.[41] Vanadium uses ions of the same metal on both sides of the reaction, which prevents the crossover degradation that occurs in other flow batteries as ions try to cross the cell membrane.[42] Zinc-bromine combines the features of a conventional battery and flow battery: One electrolyte is stored in an external tank and the other is stored internally in the electrochemical cell. The zinc-bromine chemistry allows higher power and energy densities than other flow batteries but bromine is also corrosive and can lead to component degradation and failure.[43]

Deployments: Vanadium flow batteries are the most mature and commercially deployed systems, as can be seen in Figure L-12. Of the approximately 20 MW/47 MWh of flow battery capacity installed globally, 19 MW/45 MWh are vanadium batteries.

Figure L-12: Five Largest Operational Flow Battery Energy Storage Projects[44]

Five Largest Operational Flow Battery Energy Storage Projects				
Owner / Project	**Power / Energy (Duration)**	**Technology**	**Location**	**Primary Function**
GuoDian LongYuan (Shenyang) Wind Power Co. / GuoDian LongYuan Wind Farm VFB	5 MW / 10 MWh (2 hour)	Vanadium redox	Liaoning, China	Renewable generation shifting
State Grid Corporation of China / Zhangbei National Wind and Solar Energy Storage and Transmission Project	2 MW / 8 MWh (4 hour)	Vanadium redox	Hebei, China	Renewable generation shifting
J-Power / Tomamae Wind Farm	4 MW / 6 MWh (1.5 hour)	Vanadium redox	Hokkaido, Japan	Renewables capacity firming
Sumitomo Electric Industries / Yokohama Works VRB	1 MW / 5 MWh (5 hour)	Vanadium redox	Kanagawa Japan	Renewable generation shifting
Prudent Energy / Gills Onions VRB	0.6 MW / 3.6 MWh (6 hour)	Vanadium redox	Oxnard, CA	Grid-connected commercial (reliability & quality)

41 / Horne/ESTAP (2014)
42 / IEC (2011)
43 / Sandia (2013)
44 / DOE GESDB (2015)

Worldwide, approximately 56 MW/228 MWh of operational flow battery deployments are planned or under construction.[45]

Supercapacitors. Also called electrochemical double-layer capacitors and ultracapacitors, this technology class bridges the gap between batteries and traditional capacitors; it stores energy electrostatically. Supercapacitors are characterized by low internal resistance, which allows rapid charging and discharging, very high power density (but low energy density) and high cycle life.[46] Current deployments are primarily used in voltage support, ramping and regenerative braking in transportation applications. Most are between 300 kW/3 kWh and 1 MW/17 kWh. The technology is still considered to be in demonstration phase.[47]

Technical Details: Supercapacitors use carbon electrodes with very high surface area to create a solid-liquid interface that allows electricity to be stored by the separation of charge, rather than through chemical transformation like traditional batteries.[48] Advantages of supercapacitors include high power density (40-120kW/l), very fast response time (<1 seconds), high efficiency (80 percent to 98 percent), and high cycle life (10k-100k).[49] Disadvantages include low specific energy (30Wh/kg) and corresponding high cost per kWh.

Deployments: Fourteen operational deployments are listed in the DOE Global Energy Storage Database; 11 are rated 1 MW or greater. Total installed capacity is approximately 21.5 MW/0.1 MWh, and the largest projects are summarized in Figure L-13. Supercapacitors installed as standalone energy storage systems focus almost exclusively on providing near-instantaneous voltage ramping and regenerative braking for trains.

45 / DOE GESDB (2015)
46 / IEA-ETSAP/IRENA (2012)
47 / SBC Energy Institute (2013), Sandia ES Handbook (2013)
48 / S. Badwal et al. (2014)
49 / SBC Energy Institute (2013)

Figure L-13: Five Largest Operational Supercapacitor Energy Storage Projects[50]

Five Largest Operational Supercapacitor Energy Storage Projects				
Owner / Project	**Power / Energy (Duration)**	**Technology**	**Location**	**Primary Function**
Electrical Power worX / LIRR Malverne WESS: Ioxus	1 MW / 16 kWh (1 minute)	Ultracapacitor	Malverne, NY	Transportation Services
Electrical Power worX / LIRR Malverne WESS: Maxwell	1 MW / 16 kWh (1 minute)	Ultracapacitor	Malverne, NY	Transportation Services
Incheon Transit Corporation / Incheon Line 1 - Technopark Station	2.3 MW / 13 kWh (33 seconds)	Ultracapacitor	Incheon, South Korea	Transportation Services
Seoul Metro / Seoul Line 2 - Seocho Station	2.3 MW / 13 kWh (33 seconds)	Ultracapacitor	Seoul, South Korea	Transportation Services
Seoul Metro / Seoul Line 4 - Ssangmun Station	2.3 MW / 13 kWh (33 seconds)	Ultracapacitor	Seoul, South Korea	Transportation Services

According to the DOE Global Energy Storage Database, 56 MW/452 kWh of additional deployments are planned or under construction.[51]

50 / DOE GESDB (2015)
51 / DOE GESDB (2015)

Mechanical Storage

Mechanical storage technologies use compressed air and flywheels to store energy.

Compressed Air. Compressed air energy storage (CAES) resources compress air and store it in a reservoir, typically underground caverns or above-ground storage pipes or tanks. Underground facilities are considered less expensive than aboveground and can operate for between 8 and 26 hours; however, siting underground compressed air storage facilities requires finding geologically suitable caverns.[52] Above-ground facilities are more modular and less location-sensitive. According to the DOE, the typical above-ground compressed air storage facility is in the 3 MW to 50 MW power range, with durations of two to six hours;[53] however, the additional incremental cost is significant. DOE cites cost of between $4,900 and $5,000 per MW for a 50 MW/5 hour above-ground system.[54] Figure L-14 shows operational compressed air storage facilities.

Figure L-14: Five Largest Operational Compressed Air Storage Facilities[55]

Owner / Project	Nominal Power / Energy (Duration)	Technology	Location	Primary Function
E. ON / Kraftwerk Huntorf	321 MW / 642 MWh (2 hours)	In-ground natural gas combustion	Elsfleth, Germany	Electric energy time-shift
PowerSouth Utility Cooperative / McIntosh CAES Plant	110 MW / 2,860 MWh (26 hours)	In-ground natural gas combustion	McIntosh, AL	Electric energy time-shift
General Compression, Inc. / Texas Dispatchable Wind	2 MW / 500 MWh (250 hours)	In-ground iso-thermal	Seminole, TX	Renewable generation shifting
SustainX Inc. / Isothermal Compressed Air Energy Storage	1.5 MW / 1.5 MWh (1 hour)	Modular iso-thermal	Seabrook, NH	Renewable generation shifting
Highview Power Storage / Pilot Plant	.35 MW / 2.45 MWh (7 hours)	Modular	Slough, United Kingdom	Renewable generation shifting

52 / DOE-EPRI 2013 *Energy Storage Handbook*, p.38.
53 / Ibid, p.38.
54 / Ibid, p.39-40.
55 / DOE GESDB (2015)

Flywheels. Flywheels are the other mechanical energy storage technology. They accelerate a rotor (flywheel) to a very high speed in a very low-friction environment. The spinning mass stores potential energy to be discharged as necessary. Flywheels are modular and can range from 22 kW in size (Stornetic's EnWheel) to 160 kW (Beacon Power).

Flywheels are best for short-duration, high power, high-cycle applications. They also have a much longer cycle life than other storage alternatives. Flywheels are less heat sensitive than batteries and they last longer (up to 20 years guaranteed performance). Power grid uses include voltage/VAR support and frequency regulation. Primary competitors to flywheels are supercapacitors or ultracapacitors.

Figure L-15: Five Largest Operational Flywheel Facilities[56]

Owner / Project	Nominal Power / Energy (Duration)	Location	Primary Function
European Fusion Development Agreement / EFDA JET Fusion Flywheel	400 MW / 3.3 MWh (50 seconds)	Abingdon, United Kingdom	Onsite power
Max Planck Institute, EURATOM Association / ASDEX-Upgrade Pulsed Power Supply System	387 MW / 0.77 MWh (12 seconds)	Bavaria, Germany	Onsite power
Spindle Grid Regulation, LLC / Beacon Power 20 MW Flywheel Plant	20 MW / 5 MWh (15 minutes)	Stephentown, NY	Frequency regulation
Spindle Grid Regulation, LLC / Beacon Power 20 MW Flywheel Plant	20 MW / 5 MWh (15 minutes)	Hazle Township, PA	Frequency regulation
NRStor Inc. / Minto Flywheel Energy Storage Project	2 MW / 0.5 MWh (15 minutes)	Ontario, Canada	Frequency regulation

56 / DOE GESDB (2015)

Thermal Storage

Thermal storage comes in many forms; the most well-known bulk thermal storage solution is molten salt. Paired with solar thermal generation plants, molten salt thermal storage is used to improve the dispatchability of concentrated solar power (CSP) facilities. The stored energy powers steam turbines to continue generation after the solar day has ended. Because PSE has no thermal solar generating facilities and no plans to acquire such, this technology is not explored further in this assessment.

Figure L-16: Five Largest Operational Bulk Thermal Storage Facilities[57]

Owner / Project	Nominal Power / Energy (Duration)	Technology	Location	Primary Function
Abengoa Solar / Solana Solar Generating Plant	280 MW / 1,680 MWh (6 hours)	Molten salt	Gila Bend, AZ	Renewable generation shifting
Brazos Electric Cooperative / TAS Texas Cooperative	90 MW / 1,080 MWh (12 hours)	Chilled water	Joplin, TX	Electric supply capacity
Abengoa Solar / Kaxu Solar One	100 MW / 250 MWh (2 hours, 30 minutes)	Molten salt	Northern Cape, South Africa	Renewable generation shifting
ACS - Cobra Group / Manchasol 2 Solar Plant	50 MW / 375 MWh (7.5 hours)	Molten salt	Alcazar de San Juan, Spain	Renewable generation shifting
Ortiz – TSK –Magtel / La Africana Solar Plant	50 MW / 375 MWh (7.5 hours)	Molten salt	Posadas, Spain	Renewable generation shifting

Other forms of thermal storage are more distributed in nature. These primarily interact with building heating and cooling systems and support demand-side services such as demand response. Some technologies, such as direct load control of water heaters, have already demonstrated deployment in electrical and heating networks. SCE and PG&E recently awarded contracts to IceEnergy for distributed thermal storage to reduce air conditioning loads. Although promising, many of these technologies are aimed at reducing peak loads during high temperature periods; since PSE is a winter-peaking utility, they are not necessarily a good fit for PSE or our customers' needs.

57 / DOE GESDB (2015)

Bulk Gravitational Storage

Bulk gravitational storage includes technologies such as pumped hydro and gravel in railcars.

Pumped Hydro. Pumped hydro is a mature technology used throughout North America and the world. Off-peak power is used to pump water from a lower reservoir to a higher reservoir; then the water is released to generate electricity during peak periods. Because pumped hydro facilities require above ground reservoirs, specific land configurations are needed. Pumped hydro projects are rarely located close to urban centers, and permitting can take many years due to their large environmental impact.

Figure L-17: Operational Pumped Hydro Storage in Washington State

Owner / Project	Nominal Power / Energy (Duration)	Location	Primary Function
Bonneville Power Administration / John W. Keys III Pump-Generating Plant	314 MW / 25,120 MWh (80 hours)	Grand Coulee, WA	Electric supply capacity

Gravel/Railcar. The gravel/railcar storage method operates in a similar manner to pumped hydro. Off-peak power is used to move rail cars filled with gravel or another heavy material up a slope. When power is needed, the railcar moves down the slope, converting gravitational energy into electricity as it moves down.

Unlike pumped hydro, railcar/gravel energy storage does not require reservoirs to function. Rather, it requires a long slope of existing or new railroad track. This makes it potentially easier to site than pumped hydro, although it is still not suitable for urban areas, nor is it suitable for railroad segments where there is existing traffic.

Figure L-18: Planned Railcar Energy Storage Facility

Owner / Project	Nominal Power / Energy (Duration)	Location	Primary Function	Status
ARES North America / Advanced Rail Energy Storage Nevada	50 MW / 12.5 MWh (15 minutes)	Pahrump, NV	Load following, voltage support	Announced

DEVELOPMENT CONSIDERATIONS

Siting Storage

The siting of an energy storage resource is an important consideration for development feasibility; it affects both costs and benefits. Some resources, like pumped hydro, must be located in areas with specific geology, water access and transmission lines. Natural gas combustion turbines have similar constraints, plus they face air emissions constraints in many locations as well. Many forms of storage, particularly batteries and ice energy, are more flexible when it comes to sizing and siting. Battery resources can be sized from 20 kW to 1000 MW and sited at the customer's location or interconnected to the transmission system. Other factors may also limit where storage can be located, among them space availability, permitting and interconnection upgrade requirements. A few examples of different siting options for battery storage resources follow.

54 kW/54 kWh customer-sited lithium-ion battery.

1 MW/2 MWh customer-sited lithium-ion battery.

4 MW/2 MWh distribution-connected lithium-ion battery

Proposed 100 MW/400 MWh transmission-connected battery.

Development Timelines

Different energy storage resources have significantly different project development timelines. These range from months to years, depending on the technology type, siting, size, permitting and interconnection requirements.

Pumped Hydro and CAES. Pumped hydro and CAES storage facilities, due to their size and environmental impacts, require significantly longer development timelines for analysis, design and extensive permitting activity than many storage resources. It can take 5 to 10 years (or more) to complete one of these projects, depending on public support or opposition for a particular project, the ability to negotiate environmental impact studies and other necessary approvals. Their large size and often remote location also may mean that new transmission is needed; obtaining the necessary permits and regulatory approvals required to start transmission construction can also take years, although this activity may take place concurrently with storage facility planning.

Batteries and Flywheels. Battery or flywheel storage projects can move from concept to commissioning in two to three years. Smaller systems (in the 1 MW to 5 MW) range have been commissioned in less than two years. Timeframes are even shorter for the modular containerized systems that can be installed in the field; these can be brought online within months after they reach the project site.[58] Customer-sited energy storage could be deployed in a matter of months, assuming the systems become standardized and the interconnection process is streamlined, as has happened with distributed solar systems.

Large-scale development projects (20+ MW) are subject to the requirements of the FERC-mandated Large Generator Interconnection Process. PSE would be required to complete interconnection studies before an interconnection agreement could be signed. After the agreement is obtained, it can take anywhere from six months to several years before the project is ready to interconnect to the grid, depending on the complexity of the required interconnection facilities.

58 / *DOE/EPRI 2013 Electricity Storage Handbook in Collaboration with NRECA, Sec. 4.3*

PSE STORAGE ANALYSIS

Technologies Modeled

PSE chose two categories of storage technologies to evaluate in this IRP analysis. The resources had to be commercially available at large scale and feasible to develop and bring online by 2018. The resources that met these criteria were:

- Electrochemical storage (batteries)
- Pumped hydro

Ultimately, three energy storage/flexibility sensitivities were tested in the Base Scenario for the 2015 IRP.[59]

1. 80 MW of battery storage was added to the portfolio in 2023 instead of the peaker economically chosen by the analysis.
2. 80 MW of pumped hydro storage was added to the portfolio in 2023 instead of the economically chosen peaker.
3. 200 MW of pumped hydro storage was added to the portfolio in 2023 instead of the economically chosen peaker.

In the following pages, we explain the rationale for selection of these alternatives and the cost assumptions used in the analysis. The results of these analyses are presented in Chapter 6, Electric Analysis.

Selecting Battery Technology. Within the battery category, there are many promising chemistries to choose from. To choose a single chemistry to represent the "generic battery," PSE assessed the different chemistries' readiness for large-scale deployment using the DOE Global Energy Storage Database (2014) to review the ten largest electrochemical storage projects in the world (by both power rating and energy rating) and the 10 largest projects announced or under construction.[60] These are described in Figures L-19, L-20 and L-21.

59 / See Chapter 4, Key Analytical Assumptions for a discussion of the portfolio sensitivities reviewed in the 2015 IRP.
60 / http://www.energystorageexchange.org/

Figure L-19: Largest Operational Electrochemical Storage Projects by Power Rating (MW)[61]

Owner / Project	Power / Energy	Technology	Location	Primary Function
Duke Energy / Notrees	36 MW / 24 MWh	Advanced lead acid	Goldsmith, TX	Renewables capacity firming, electric energy time-shift; frequency regulation
Japan Wind Development / Rokkasho Village Wind Farm	34 MW / 238 MWh	Sodium sulfur	Rokkasho Village, Japan	Renewables capacity firming, renewables energy time-shift; capacity spinning reserves
AES / Laurel Mountain	32 MW / 8 MWh	Lithium-ion	Elkins, WV	Frequency regulation and ramping
GVEA / Battery Energy Storage System	27 MW / 6.8 MWh	Nickel cadmium	Fairbanks, AK	Capacity spinning reserves, grid-connected residential (reliability), grid-connected commercial (reliability & quality)
BYD / Shenzen	20MW / 40MWh	Lithium-ion	Shenzen, China	Self-regulation of load, peak shaving
AES / Angamos	20 MW / 6.6 MWh	Lithium-ion	Mejillones, Chile	Frequency regulation and capacity spinning reserves
AES / Tait	20 MW / unknown	Lithium-ion	Moraine, OH	Frequency regulation
NextEra - Frontier	20MW / unknown	Lithium-ion	Illinios	Frequency regulation
AES / Los Andes	12 MW / 4 MWh	Lithium-ion	Atacama, Chile	Frequency regulation and capacity spinning reserves
Sempra / Auwahi Wind Farm	11 MW / 4.4 MWh	Lithium-ion	Kula, HI	Wind ramping

61 DOE GESDB (2014)

Figure L-20: Largest Operational Electrochemical Storage Projects by Energy Rating (MWh)[62]

Owner / Project	Power / Energy	Technology	Location	Primary Function
Japan Wind Development / Rokkasho Village	34 MW / 238 MWh	Sodium sulfur	Rokkasho Village, Japan	Renewables capacity firming, renewables energy time shift, spinning reserves
Tokyo Metropolitan Government Bureau of Sewage / Morigasaki	8 MW / 58 MWh	Sodium sulfur	Ota-ku, Japan	Electric bill management, electric energy time-shift
Hitachi Ltd., Automotive Systems Group / Hitachi Automotive Plant	9 MW / 54 MWh	Sodium sulfur	Hitachinak a, Japan	Electric bill management, electric energy time-shift
Abu Dhabi Water & Electricity Authority / ADWEA	8 MW / 48 MWh	Sodium sulfur	Abu Dhabi, United Arab Emirates	Electric energy time-shift
BYD / Shenzen	20MW / 40MWh	Lithium-ion	Shenzen, China	Self-regulation of load, peak shaving
State Grid Corporation of China / Zhangbei	6 MW / 36 MWh	Lithium-ion	Zhangbei, China	Renewable generation shifting, renewable capacity firming, frequency regulation
Southern California Edison / Tehachapi	8 MW / 32 MWh	Lithium-ion	Tehachapi, CA	Voltage support, electric capacity, renewables capacity firming, transmission congestion relief
American Electric Power / Presidio	4 MW / 32 MWh	Sodium sulfur	Presidio, TX	Reliability and power quality, electric capacity, non-spinning reserves, voltage support
Okinawa Electric Power Company / Miyako Island	4 MW / 28.8 MWh	Sodium sulfur	Miyakojima Japan	Renewables capacity firming, renewables generation shifting
Pacific Gas & Electric Company / Yerba Buena	4 MW / 28 MWh	Sodium sulfur	San Jose, CA	Grid-connected commercial (reliability and quality), frequency regulation, renewables capacity firming, on-site power

[62] *DOE GESDB (2014)*

Figure L-21: Largest Electrochemical Storage Projects Announced or Under Construction, by Power Rating (MW)[63]

Owner / Project	Power / Energy (MW/MWh)	Tech	Location	Status	Primary Function
AES / Alamitos	100 MW / 400 MWh	Lithium-ion	Los Alamitos, CA	Announced	Flexible supply capacity
AES / Kilroot	50 MW / unknown	Lithium-ion	Carrickfergus, N. Ireland	Announced	Renewables capacity firming, renewables energy time-shift
Tohoku Electric / Sendai Substation	40 MW/ 20 MWh	Lithium-ion	Sendai, Japan	Under construction	Frequency regulation, voltage support
Invenergy / Grand Ridge	31.5 MW / 12.1 MWh	Lithium-ion	Marseilles, IL	Under construction	Non-spinning capacity reserves
Invenergy / Beech Ridge	31.5 MW / unknown	Lithium-ion	Rupert, WV	Under construction	Frequency regulation, ramping, renewables capacity firming
Alaska Railbelt Cooperative / Anchorage Area ESS	25 MW / 14.1 MWh	Lithium-ion	Anchorage, AK	Announced	Spinning electric supply reserves, transmission/distribution upgrade deferral, electric energy time-shift
AES / Cochrane	20 MW / 6.3 MWh	Lithium-ion	Mejillones, Chile	Announced	Supply capacity, electric energy time-shift
RES Americas / Jake	20 MW / 7.9 MWh	Lithium-ion	Illinois	Under construction (?)	Frequency regulation
RES Americas / Elwood	20 MW / 7.9 MWh	Lithium-ion	Illinois	Under construction (?)	Frequency regulation
Imperial Irrigation District 20 MW BESS	20 MW / unknown	Lithium-ion	Imperial, CA	Announced	Spinning electric capacity reserves, renewable generation shifting, renewables capacity firming

[63] *DOE GESDB (2014)*

Based on this review, PSE chose to model lithium-ion as the large-scale generic battery resource in this IRP for the following reasons:

1. The majority of large projects (especially those announced or under construction) use lithium-ion technology.
2. Cost estimates are more readily available in publically accessible data (though not complete).
3. More data is available on the spectrum of system configurations and sizes, including the on the sizing and timing of systems announced in Southern California Edison's Local Capacity Resources procurement.

For an actual RFP solicitation, PSE will evaluate all proposed technologies based on least-cost and best-fit criteria, including technical and commercial considerations such as warranties, performance guaranties and counterparty credit, etc.

Sizing Assumptions

Unlike conventional generation resources like combustion turbines, battery storage resources are modular, scalable and expandable. It is possible to build the infrastructure for a large storage system and install storage capacity in increments over time as needs grow. This flexibility is a valuable feature of the technology.

Battery Storage Sizing. To simplify the scope of this analysis we modeled 80 MW of generic lithium-ion battery storage resources.

In the next step, we defined energy storage capacity (MWh). To be cost effective, battery systems must have sufficient storage to provide necessary grid services, but without being prohibitively expensive due to extremely long discharge duration. Through prior modeling, PSE determined that a two-hour battery storage system would earn a 100 percent incremental capacity equivalent (ICE) for supply capacity. This should be more than sufficient for system flexibility/ancillary services applications, which require less than one-hour discharge duration.

Pumped Hydro Sizing. Pumped hydro resources are generally large, on the order of 100 MW to 3,000 MW. Most development proposals that PSE has seen have been greater than 400 MW. PSE would not need to purchase the output of an entire plant, as long as others were interested in splitting the output of a particular project. Most likely, any potential pumped hydro resource acquisition would be for a "slice" of the resource, not the entire facility output. This analysis tests two amounts of pumped hydro storage, 80 MW and 200 MW. Both are assumed to be a portion of a larger facility. Based on recent project proposals we have seen, 10 hours of discharge duration is common, so the 80 MW alternative represents 800 MWh and the 200 MW alternative represents 2,000 MWh.

Performance Metrics

Key performance metrics for storage resources include the charge and discharge rates and round-trip efficiency (RTE).

Charge/Discharge Power. Some batteries can discharge at a higher power than they can recharge, others can charge and discharge at equal rates. This affects the overall value of the resource, since ancillary services and flexibility require both the injection and withdrawal of power from the grid.

Round-trip Efficiency. Round-trip efficiency (RTE) refers to the amount of energy that an energy storage system (ESS) can deliver to the grid relative to the amount of energy it withdraws from the grid ESS during its preceding charge cycle. The RTE of energy storage technologies varies substantially. Higher round-trip efficiency is more desirable, all else equal. Differences among technology classes can be significant, but differences due to operational profiles and the environment can be even greater. An average AC-to-AC 85 percent round-trip efficiency for the generic resources system is assumed for this analysis. This does not include standby losses. These are not well known, but they are likely to be an important metric to consider for an actual acquisition.

Degradation. Cycling on the battery system creates wear and tear that eventually causes the system to begin to lose *energy* storage capability over time. Charge and discharge *power* are not affected. The exact amount of degradation that will occur depends on the specific chemistry and the frequency and nature of cycling. For this analysis, we assume a degradation rate of 2 percent per year. At this rate, a 20-year-old system would have about 68 percent of the storage capacity it had when new.

Generic Costs

There is no simple formula for estimating the cost of storage resources at this time. Most systems are custom-designed, built and tailored for very specific, customer-identified applications and sites, so costs vary significantly.

Generic Battery System Costs.

PSE reviewed publicly available cost data from existing projects and market research reports that discussed cost trends and estimates for projects recently contracted in California and Hawaii. We also consulted with experienced battery storage project developers regarding recent cost estimates specific to the size of the generic resource being modeled.

PILOT PROJECTS REVIEWED. Few examples are available of detailed costs for large, completed grid-scale systems. We looked closely at two projects: SCE's Tehachapi Wind Energy Storage Project and PSE's Glacier project in Whatcom County.

SCE commissioned the Tehachapi Project, an 8 MW/32 MWh lithium-ion system, in June 2014 with the help of a U.S. Department of Energy grant. When the project was approved for the American Recovery and Reinvestment Act Smart Grid Demonstration Program Funding in 2010, total project cost was estimated at $50,000,000. Actual incurred costs are unknown, but this provides a useful cost data point of $6,250 per kW and $1,562 per kWh. This includes batteries, battery operating systems (BOS), interconnection and every other component.

PSE's 2 MW/4.4 MWh lithium-ion Glacier project in Whatcom County is estimated to cost approximately $11,800,000, which translates to approximately $5,900 per kW and $2,682 per kWh. Economies of scale are important for system costs, which is why the cost per kilowatt-hour for PSE's system is higher than for the SCE Tehachapi system.

Significant non-recurring design, engineering and integration costs are included in both projects, so they may be more costly than future deployments. Many fixed costs don't scale dramatically as the project size increases; permitting and interconnection study costs for a 2 MW project and a 20 MW project are largely the same, for example.

The above pilot projects were priced in 2009 and 2013, respectively. Forward pricing for storage systems delivered in 2018 is significantly lower due to substantial market expansion and increased competition in both the battery and balance-of-systems marketplace. For these reasons, direct cost comparisons between these pilots and the larger-scale 80 MW deployment modeled here have only limited usefulness. They are instructive, however, in terms of showing a cost ceiling.

Battery Cell Costs. The majority of publicly available price research focuses on battery cell costs, especially lithium-ion, because of its widespread use in the electric vehicle market and the transparency of that pricing. Brattle Group, Bloomberg New Energy Finance, Morgan Stanley, CITI Research and Navigant Research all project lithium-ion prices will decrease significantly over the next few years. Price estimates for 2014 ranged from $350 to $700 per kWh. Combining and averaging these sources into one analysis, IBM Research - Australia estimated the current price at approximately $600 per kWh. This is supported by a December 2014 report from UBS. When IBM Research examined future cost projections in the 2015–2020 timeframe, they estimated a range of $200 per kWh to $354 per kWh. Many of the studies averaged were from 2011 and 2012, so they do not reflect the cost reductions experienced in the last few years. In 2014, Tesla estimated its battery cell costs in the $200 to $300 per kWh range.

Based on conversations with an experienced storage resource developer, PSE combined cell cost, battery management system and enclosure costs because these components generally scale with the amount of energy storage (kWh). Estimates ranged from $390 per kWh to $380 per kWh for the 80 MW system, reflecting economies of scale and buying power for the larger system. Given the general trend towards declining prices and the economies of scale that can be obtained with large systems, we believe these cost estimates to be reasonable.

Balance of Systems and Construction Costs. Grid-interconnected batteries require many components in addition to battery cells. Known as balance-of-system (BOS) components, these include power electronics (inverters), control modules, enclosures, interconnection studies and facilities, permitting, installation materials and labor, and contingencies. The Rocky Mountain Institute (RMI) estimates that BOS represents 63 percent of the total installed cost for a 200 kW/200 kWh commercial energy storage system, and 74 percent for a residential system.

The largest BOS costs are associated with power electronics; this includes the inverter/power conditioning system (PCS) and control module/battery management system (BMS). UBS analysts estimate BOS costs to be in the $400 to $500 per kWh range for large-scale systems. Our discussions with vendors suggest that BOS is better evaluated on a cost per power (kW) basis rather than kWh.

For this analysis, PSE assumes $195 per kW for the 80 MW system. In addition to BOS and cell cost, PSE assumes a construction cost of 10 percent to 15 percent of the combined cell and BOS cost.

Land, Permitting and Interconnection. Many project costs, such as interconnection facilities, step-up transformers, transformer installation, switchgear, IT and communications, land and permitting, are utility- and site-specific; in a contracting agreement these constitute “owner’s costs.”

Battery System Cost Assumption Summary

A reasonably good cost comparable to the generic battery peaker storage configurations above is the 100 MW/400 MWh system that Southern California Edison recently contracted for with AES Energy Storage in its LCR procurement. UBS estimates this project to cost roughly $1,500 per kW (implying $375 per kWh). Because the project will be installed at an existing, permitted thermal plant, the land, permitting and interconnection costs likely constitute a relatively small portion the total cost, so we believe the majority of this total system cost comes from batteries and BOS.

PSE assumptions result in a total estimated system cost of $1,498 per kW for the 80 MW unit. This compares reasonably with the estimated cost for the AES-SCE project described in the paragraph above. The cost per kWh is substantially higher for the PSE generic than the SCE project because the SCE project has a 4-hour duration and the PSE generic has a 2-hour duration.

Pumped Hydro Cost Assumptions. Pumped hydro costs are difficult to generalize because they depend so heavily on facility configuration and site-specific costs. For this analysis we use estimates from the March 2014 report “Capital Cost Review of Power Generation Technologies” Prepared by Energy + Environmental Economics (E3) for the Western Electric Coordinating Council, which assumed $2,400 per kW for capex and $15 per kW per year for fixed operations and maintenance for a facility in the West that equals or exceeds 250 MW.

Figure L-22: Summary of Generic Storage Resource Assumptions

2014 $	Units	Battery	Pumped Storage Hydro
Nameplate Capacity	MW	80	200*
Winter Capacity	MW	80	200
Capital Cost	$/kW	$1,498	$2,400
O&M Fixed	$/kW-yr	$7.71	$15.00
O&M Variable	$/MWh	$0.00	$0.00
Capacity Factor	%		
Capacity Credit	%	100%	100%
Total Hours Discharge	Hours	2	10
Location		PSE	WA/OR
Fixed Transmission	$/kW-yr	$0.00	$20.83
Variable Transmission	$/MWh	$0.00	$0.34
First Year Available		2019	2030
Economic Life	Years	20	60
Greenfield Development & Construction Lead time	Years	3	15

** In this analysis, PSE modeled 200 MW and 80 MW of pumped hydro storage using the same cost assumptions.*

Methodology

This analysis evaluates the benefits of storage to the generation system, so its methodology is consistent with that used for traditional generation resources like combustion turbines and reciprocating engines. The generic storage resources are assumed to provide supply capacity, system flexibility and oversupply reduction services to the portfolio.

System Flexibility Methodology. As a Balancing Authority (BA), PSE must retain enough flexibility in the system to keep it in balance at all times, despite moment-to-moment variations in demand and generation. Energy storage may be able to provide valuable system flexibility, though it must be evaluated and compared with other resources that can provide similar flexibility.

The Pacific Northwest does not have a market for ancillary services such as regulation and spinning reserves, so PSE estimated the flexibility benefit provided by storage with a proprietary production cost model that simulates PSE's generation operations with and without energy storage in the generation resource stack. This analysis results in a record of unit deployment for PSE's dispatchable generation, quantifies how each unit contributes to system balancing, and calculates the avoided fuel and operational costs due to using the storage resource instead of traditional resource.

The Resource Integration Team modeled the generic battery system configurations using a subset of the 250 Aurora simulations used in the 2013 IRP, limited to the year 2018. In this analysis, the resulting value of the battery storage was $99.52 per kW per year. This value was considered a benefit to the resource and therefore subtracted from the total fixed operations and maintenance cost in the sensitivity analysis.

This analysis estimates the theoretical potential value of the storage resource, but further work must be done to determine if it can actually provide this value to due to control and operational issues. The operation of storage resource for system flexibility requires a high level of communications and controls and also compliance obligations and would have to meet specific regional reliability coordinator requirements.

See Appendix H, Operational Flexibility, for more information on system flexibility and for a full description of the methodology used to evaluate energy storage in this context.

Energy Supply Capacity Value Methodology. If an energy storage resource can discharge reliably during peak load conditions, it has the potential to defer or avoid the fixed costs of acquiring new generation. Since storage resources' discharge duration is limited, especially batteries, they may not be useful for peak load events and grid contingency events when extended duration is needed. To evaluate this, the IRP team performed and updated Incremental Capacity Equivalent (ICE) analysis for several storage device configurations.

The ratio of the equivalent gas peaker capacity to the alternative resource capacity is the ICE, or the capacity credit, of the alternative resource. The capacity credits for PSE's existing and prospective resources were developed by applying the ICE approach – which is similar to the equivalent load carrying capability (ELCC) approach – with our loss of load probability (LOLP) model. In essence, this identifies the equivalent capacity of a gas-fired peaker plant that would yield the same loss of load probability as the capacity of a different resource such as a wind farm, energy storage facility or even a fixed purchased power contract.

Pilot Project

Glacier Project. In partnership with the Washington State Department of Commerce, PSE is developing a battery storage pilot project in Glacier, a small town east of Bellingham, Wash. The project will involve the installation of a 2 MW/4.4 MWh lithium-ion battery system that will interconnect to the 12.5 kV distribution system near Glacier's existing substation.

Glacier is served by a radial transmission and distribution line that runs along a heavily forested scenic highway and the town experiences frequent and lengthy outages because of how challenging it is for repair crews to reach and repair the lines during storms. The project is funded in part by a $3.8 million Smart Grid Grant from the State Department of Commerce; PSE's investment is estimated at $7.9 million.

The Glacier project tests three primary use cases:

- Outage mitigation
- System-wide peaking (supply capacity)
- System flexibility

The project is currently in the design stage. After the battery system is commissioned, Pacific Northwest National Laboratories (PNNL) will conduct four to six months of testing and evaluation. Identifying the performance and economic benefits of the project will help PSE determine the feasibility of future applications for this technology.

For more information on the Glacier project, go to:
http://pse.com/inyourcommunity/pse-projects/system-improvements/Pages/Glacier-battery-storage-project.aspx

DISTRIBUTED SOLAR

Contents

As part of PSE's continuing exploration of emerging resources, the 2015 IRP looks at the impacts of high penetration of rooftop solar installations on both the distribution system and on resource builds. Distributed solar generation has never been selected in the portfolio analysis as a cost-effective resource for the PSE system, but federal tax credits and state production incentives have made it cost-effective for customers. Already, PSE has 2,800 net-metered customers who have installed rooftop solar panels totaling 17.4 megawatts of capacity and 17,360 megawatt hours of annual energy, and we expect many more customers will install solar panels in the future.

OVERVIEW

This appendix includes the details and results from two studies.

The **Distributed Photovoltaic Technical and Market Potential** study is a system-wide study prepared by the Cadmus group that explores the maximum potential for rooftop solar within the PSE system. It asks how much distributed solar might be added to the system in two scenarios:

a) if federal and state incentives are renewed, and
b) if incentives are allowed to sunset.

This information was used as an input in the IRP portfolio analysis. The results of the portfolio analysis are discussed in Chapter 6 and in Appendix N: Electric Analysis. *The Cadmus report on the study appears at the end of this chapter.*

The second study, **Distributed Solar PV Impact at the Circuit Level**, investigates the impact that significant amounts of photovoltaic (PV) generation will have at the circuit level of the electric distribution system, particularly with regard to voltage impacts, peak demand and line losses. *This study description begins on the following page.*

DISTRIBUTED SOLAR PV IMPACT AT THE CIRCUIT LEVEL

Rooftop solar requires the existing energy system – which is built for one-way traffic (system to user) – to accommodate two-way traffic (system to user and user to system). This study looks at how this shift impacts the system.

Study Design and Assumptions

PSE analyzed three effects in particular:

VOLTAGE DROP. Does the interconnection of distributed solar generation change PSE's ability to deliver energy at a voltage that stays within the range of acceptability (114 to126 volts)?

PEAK DEMAND. Can distributed solar generation contribute to meeting peak need by reducing system load at times of peak demand?

LINE LOSSES. Does PV generation increase or decrease line losses beyond expected, base-level loss?

Circuits. Four circuits were chosen for the study. They represent different mixes of residential and commercial buildings, different feeder line lengths and different peak seasons. These are described in Figure M-1.

Figure M-1: Circuits Studied for PV Impact

Circuit ID	Location	Load Mix	Peak Season	Current # Net Meters	2014 Penetration	Length	Current Conditions
Carolina-15 (CAR-15)	Bellingham	76% Commercial 24% Residential	Winter	13	1.7%	1.5 mi	Downtown with most net meters of any commercial feeder.
Union Hill-21 (UHL-21)	Redmond	29% Commercial 71% Residential	Winter	77	4.3%	5.3 mi	Fairly heavily loaded longer feeder. Mostly residential.
Winslow-16 (WIN-16)	Bainbridge Island	51% Commercial 49% Residential	Winter	20	39%	1.0 mi	Lightly loaded short feeder with high solar penetration rate.
Evergreen-17 (EVE-17)	Redmond	100% Commercial	Summer	0	0%	0.6 mi	One of few summer-peaking feeders.

Design Days. Each circuit was studied for a winter design day and a summer design day. For each of these, maximum and minimum sun radiation days and maximum and minimum loads were identified using 2013 data selected at three-minute intervals. Together these variables established eight studies for each circuit.

LOADS

- Light Winter: winter day with lowest peak for 2013
- Heavy Winter: winter day with highest peak for 2013
- Light Summer: summer day with lowest peak for 2013
- Heavy Summer: summer day with highest peak for 2013

SOLAR RADIATION

- Summer Low Sun: day with lowest amount of sun in summer
- Summer High Sun: day with most amount of sun in summer
- Winter Low Sun: day with lowest amount of sun in winter
- Winter High Sun: day with highest amount of sun in winter

Finally, the study created a base case that assumed no solar generation. This added another study for each circuit.

Solar PV Penetration Potential. High technical potentials are assumed, since the purpose of the study is to consider the impact of high levels of solar penetration at the circuit level.

- For residential customers, 40 percent of houses are assumed to have PV systems capable of generating 5 kilowatts per house.
- For existing commercial buildings, 70 percent of roof space is assumed to be available for PV, with equipment capable of generating 15 Watts per square foot, limited to 200 kW per building.

These assumptions are at the high end of the reasonable range, and in some circuits they produce penetration that is greater than 100 percent of peak.[1] Current U.S. standards call for a system impact study when circuits reach 15 percent PV penetration, and they recommend penetration should not exceed 30 percent. The table below shows the peak capacity for each circuit, the penetration potential based on these assumptions, and the 30 percent and 15 percent penetration levels for comparison.

Figure M-2: Maximum Potential PV Penetration for Circuits Studied

Circuit ID	Peak Load MW	Max Potential PV in MW Com+Res=Total			Max Potential Penetration	30% Penetration MW	15% Penetration MW
CAR-15	4.2	4.6	1.1	5.7	135%	1.26	0.63
UHL-21	7.6	1.1	5.1	6.2	82%	2.28	1.14
WIN-16	0.6	0.3	0.1	0.4	67%	0.18	0.09
EVE-17	6.5	0.6	0.0	0.6	9%	1.95	0.975

Circuit Profiles. The following pairs of charts show how these assumptions translate into daily load curves and PV potential for each circuit. The daily load curve charts illustrate how demand on the circuit varies with seasonal conditions (heavy summer, light summer, heavy winter and light winter). The potential PV generation charts show how PV generation varies on the circuit under different solar radiation conditions (low sun summer, high sun summer, low sun winter and high sun winter). This is the basic information used to analyze each circuit.

TO READ THE CHARTS ON THE FOLLOWING PAGES: Note that the vertical axis scales differ from chart to chart. All charts use the same 24-hour timeline for the horizontal axis.

1 / PV penetration as a percentage is determined by dividing the total capacity of PV systems on the circuit (in KW) by the peak load on that circuit (in KW).

The CAR-15 circuit feeds downtown Bellingham. Its load mix is 76 percent commercial and 24 percent residential, and it experiences a winter peak.

Figure M-3: Car-15 Daily Load Curves

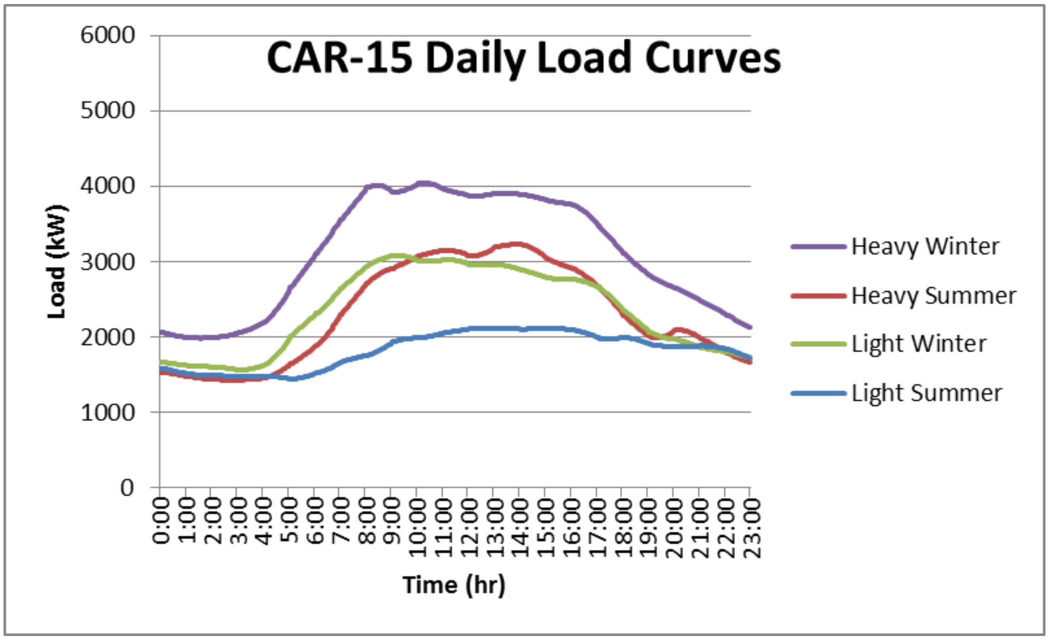
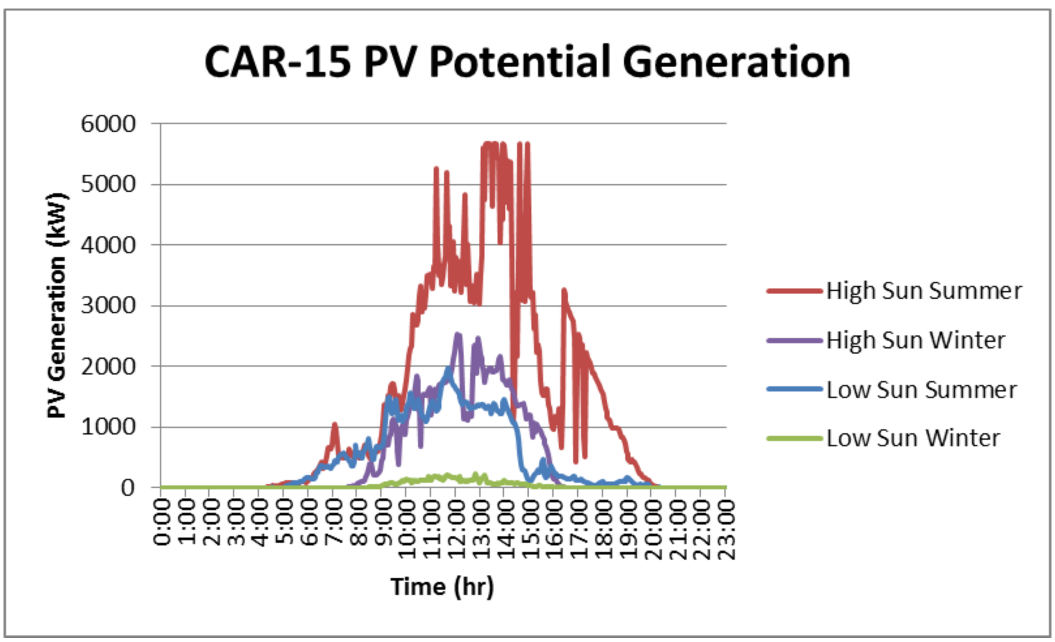


Figure M-4: Car-15 Potential PV Generation



WIN-16 on Bainbridge Island is a small circuit with a 51 percent commercial / 49 percent residential mix. The island does not have natural gas heating, so it experiences a big morning peak in winter.

Figure M-5: WIN-16 Daily Load Curves

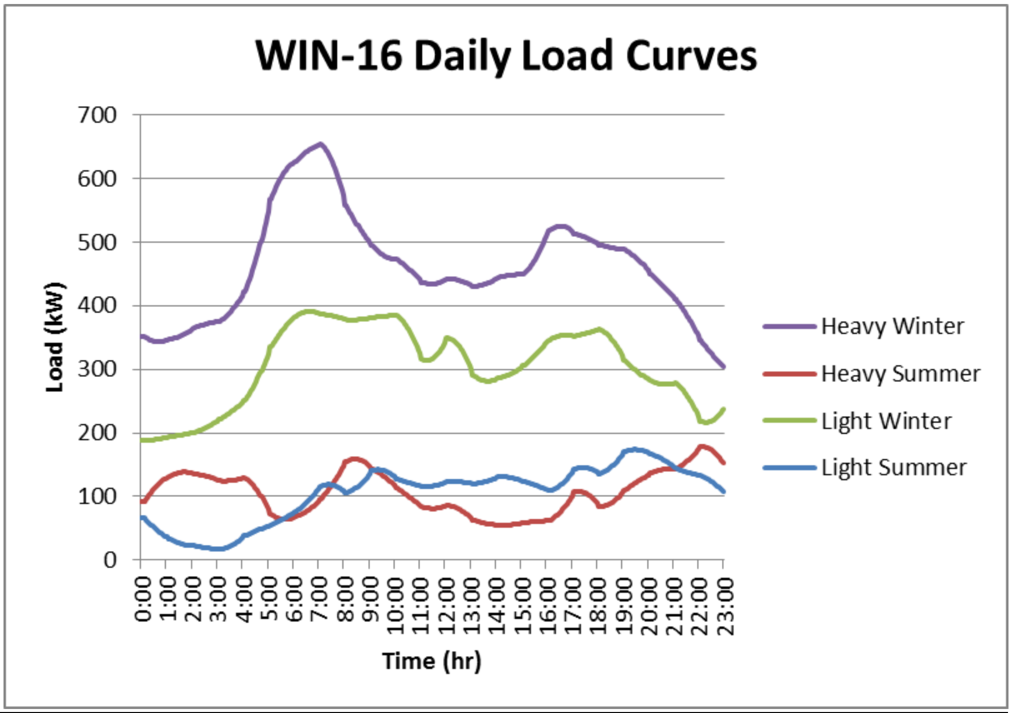
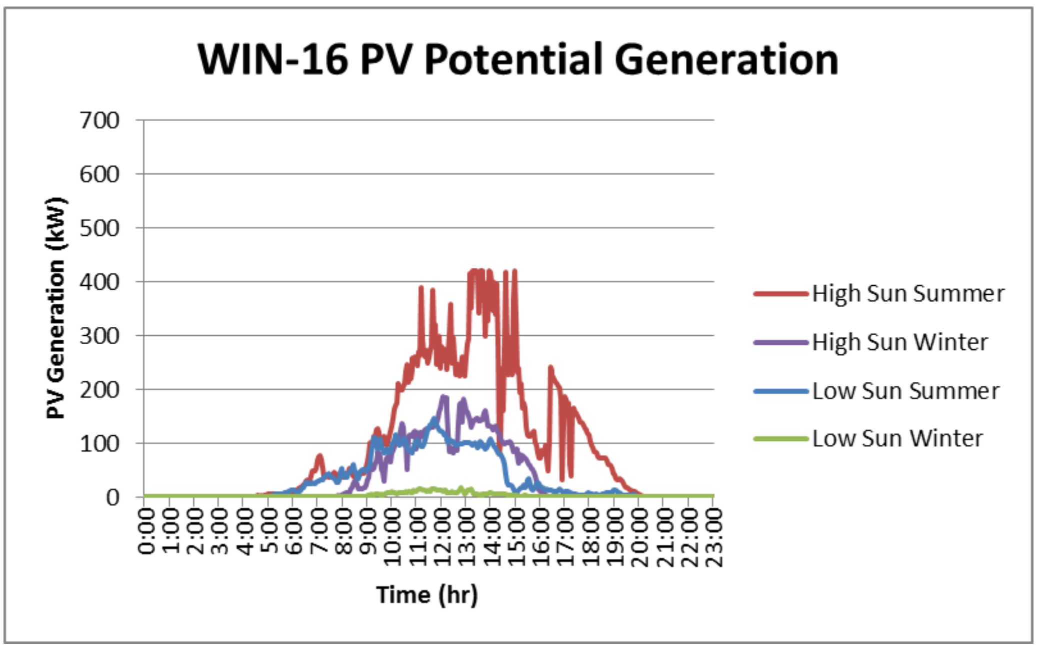


Figure M-6: WIN-16 Potential PV Generation



UHL-21 in Redmond is primarily residential (71 percent), and experiences a winter evening peak. Note that this circuit is 10 times larger than WIN-16.

Figure M-7: UHL-21 Daily Load Curves

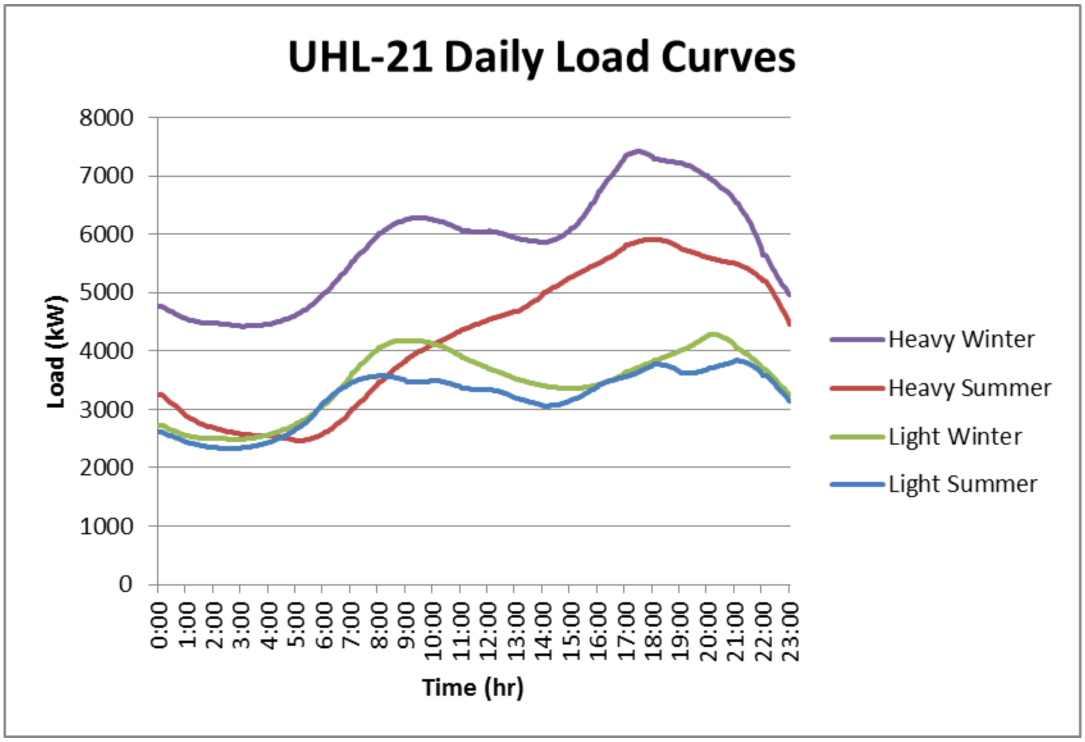
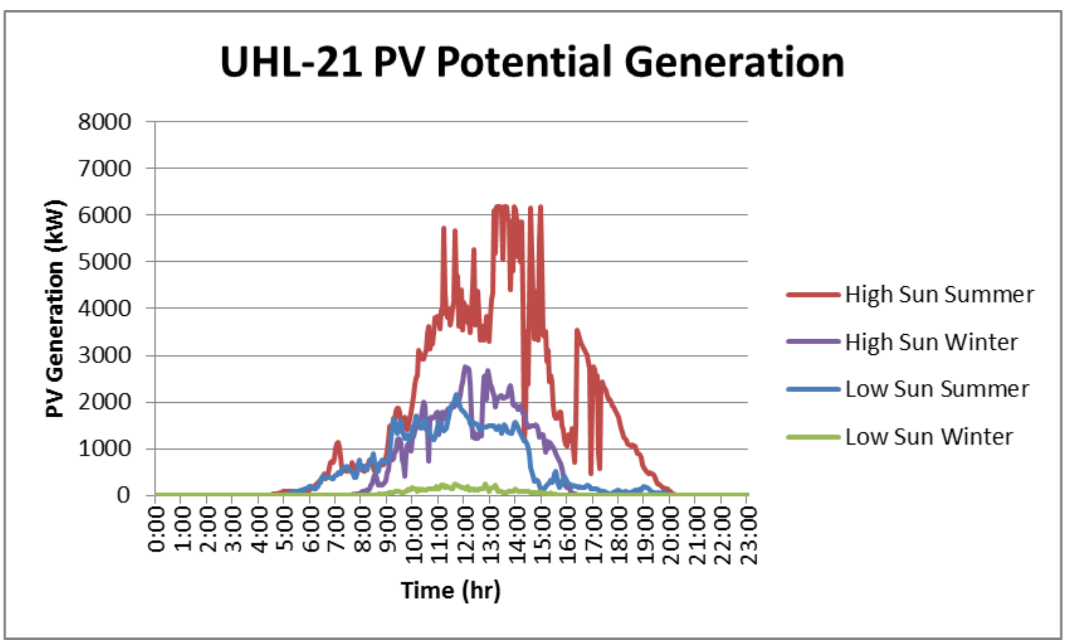


Figure M-8: UHL-21 Potential PV Generation



In Redmond, EVE-17 is an all-commercial circuit. Unlike the other three circuits, EVE-17 produces a summer afternoon peak because of the many offices it feeds. Since this circuit serves only three commercial buildings, and the maximum solar potential generation is 200 kW per building, the maximum solar potential for the entire circuit is only 600 kW.

Figure M-9: EVE-17 Daily Load Curves

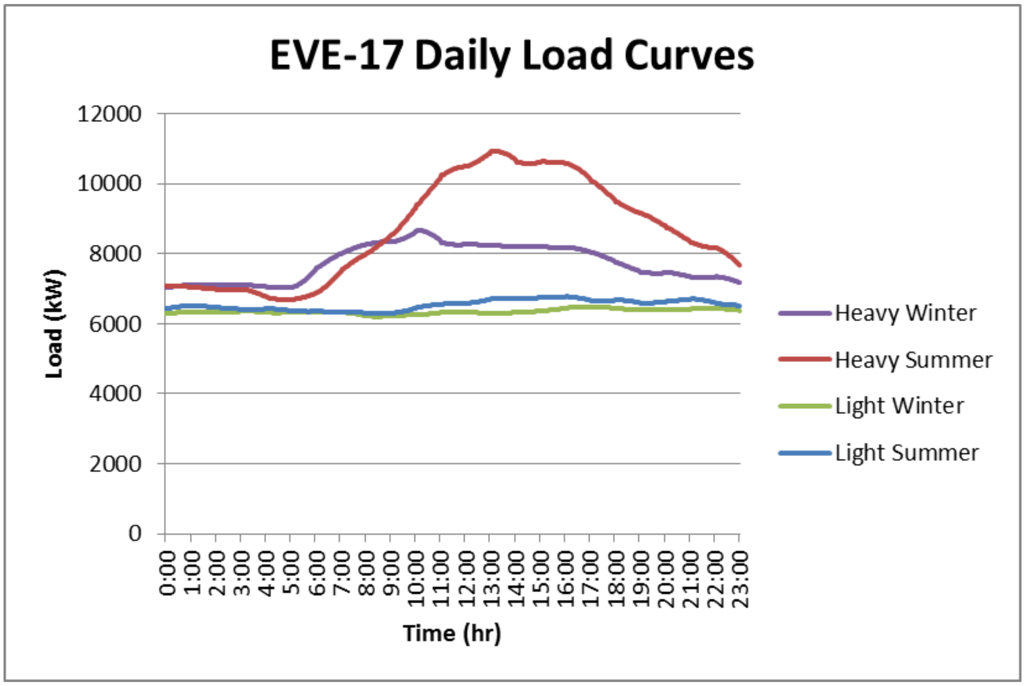
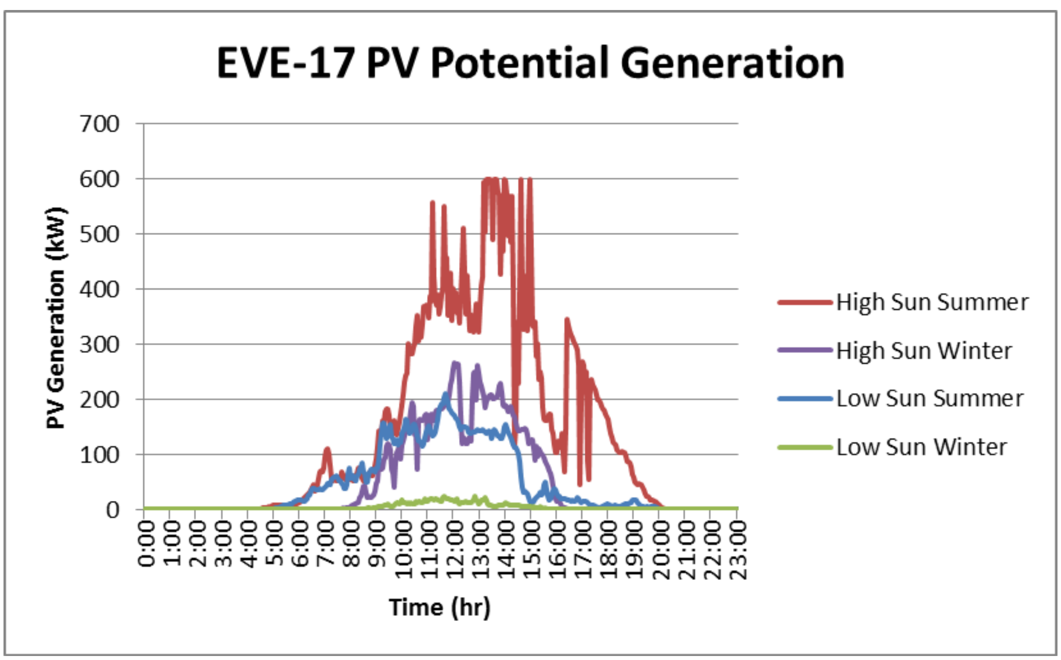


Figure M-10: EVE-17 Potential PV Generation



IMPACT ON DEMAND. The solar PV generation that customers originate is accounted for in the system as a reduction in demand because it reduces the amount of energy that PSE must supply to that circuit from other sources. The more solar PV power that is generated, the more demand is driven down, as illustrated by the red line in the charts below. The less solar power generated, the greater the demand on other PSE resources to supply energy to the circuit, as illustrated by the blue lines. Demand that PSE must fill with system resources will swing between the values shown by the blue and red lines. On CAR-15, for example, on a cloudy day in the summer when customers are using more electricity, PSE will have to provide about 2,000 kW. But on a very sunny day if customers are not using much power, PSE will be purchasing over 2,000 kW from customers.

Figure M-11: CAR-15 Net Demand Range, Summer

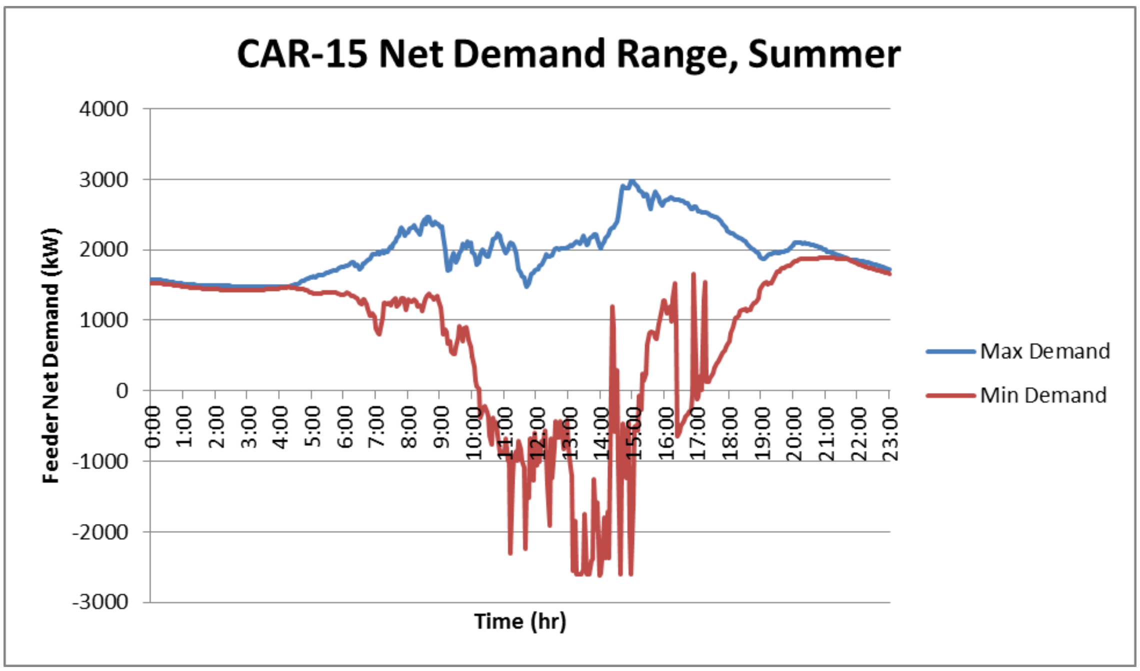


Figure M-12: WIN-16 Net Demand Range, Summer

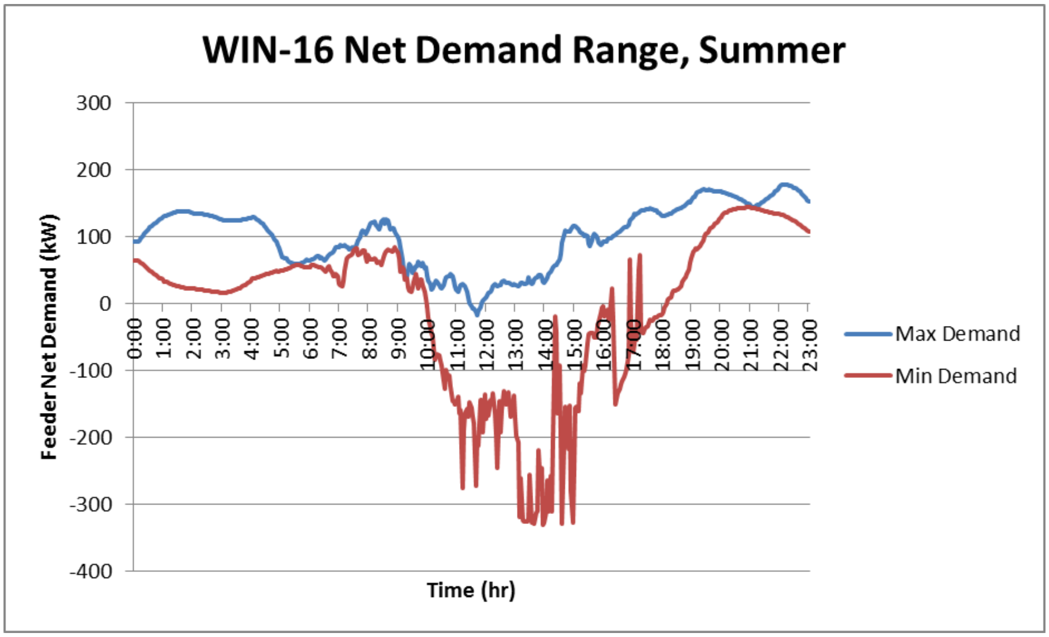


Figure M-13: UHL-21 Net Demand Range, Summer

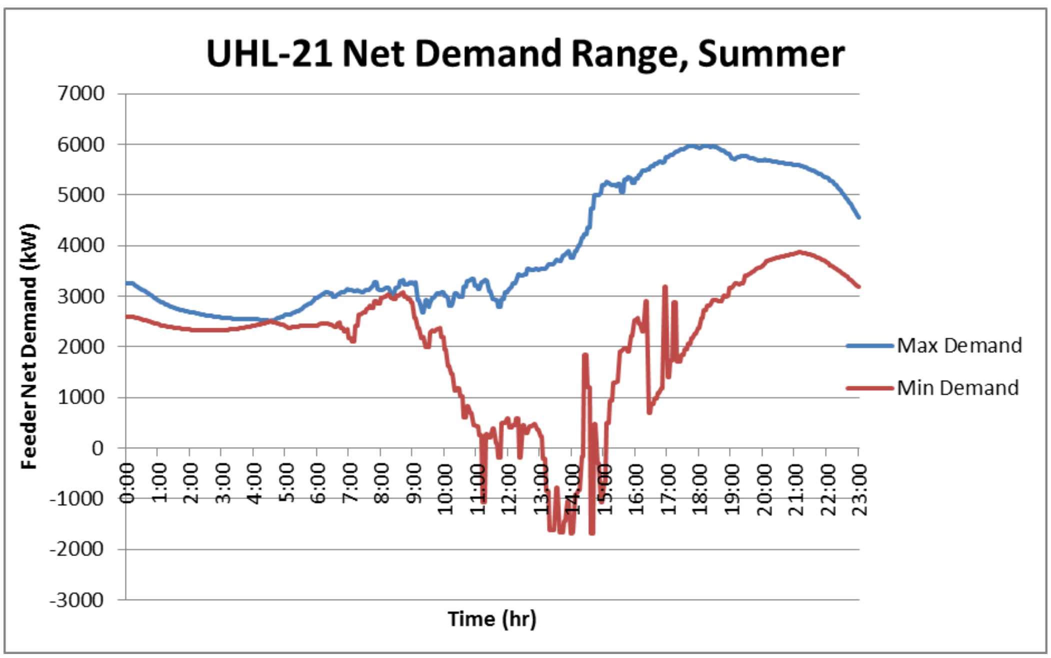
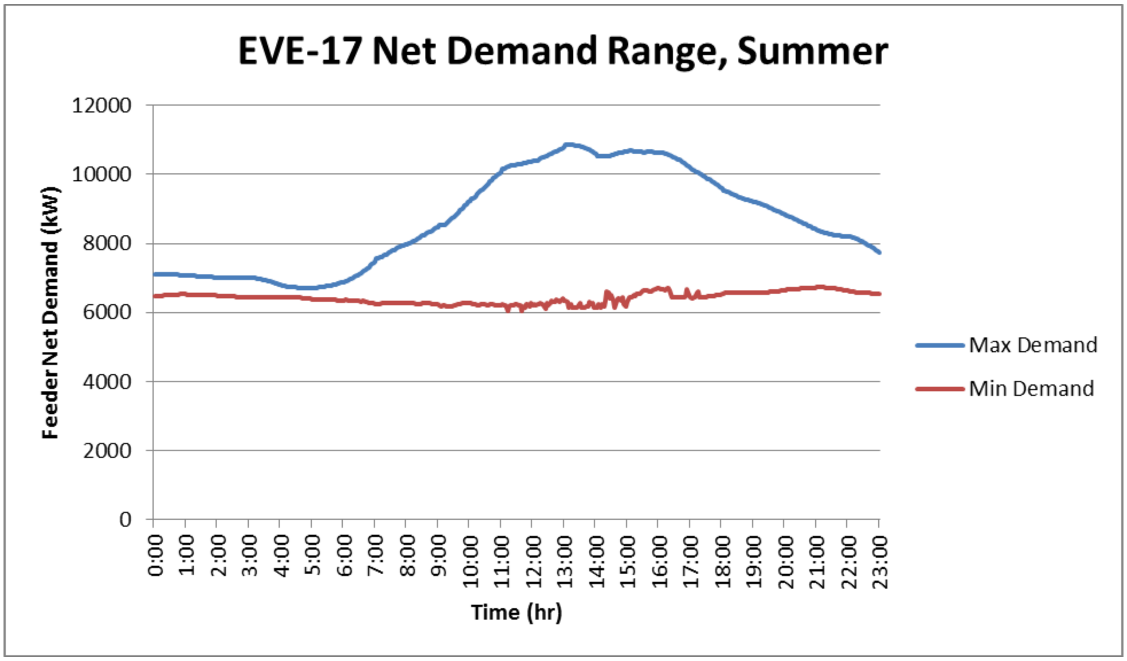


Figure M-14: EVE-17 Net Demand Range, Summer



Findings

Voltage Impacts. Distributed solar PV increases the complexity of managing voltage regulation on circuit feeders due to its intermittent nature.

Power needs to flow to customers at a relatively constant voltage level of 114 to 126 volts per ANSI standard C84.1 (the national standard for utility voltage regulation). Voltage swings outside of this range can wear down utility equipment, degrade customer appliances and create operational issues with sensitive equipment. To keep levels within the acceptable range as customer loads increase and decrease, voltage regulators installed at the substation and/or on the feeder line respond by making adjustments in real time. To prevent unnecessary adjustments, they often operate on a 30 to 40 second delay.

Solar PV adds a layer of complexity by increasing the volatility of voltage changes. When customers' solar panels export power onto the feeder, line voltage surges; when a cloud passes across the sun the PV stops producing and line voltage drops; when the sun comes back out, voltage often spikes again. This variation must now be compensated for in addition to variations in load.

The following charts show the PV generation impact on line voltage for each circuit studied. Note that while 114V is the minimum that can be served to customers, the following charts show the voltage without taking into account the voltage drop across the distribution transformer and customer connection (which can be anywhere from 2 to 6 volts depending on the customer). This means that any instances in the charts where the lowest feeder voltage dips below 120V, there is a possibility that a customer is receiving low voltage (typically verified by taking measurements at the meter following a complaint). Voltage on all circuits remains within the acceptable range, except on UHL-21 which experiences high voltages during periods of heavy solar generation. The voltage at the substation must be set to higher than 120V so that the customers at the end of the line remain within the limit despite the long length of this feeder and the high amount of load it serves.

For CAR-15, Figure M-16 shows that under light summer load conditions, significant levels of PV generation impact both the magnitude of voltage changes and the volatility of those changes on this line. Voltage increases up to 3.4 percent; voltage can also spike down briefly, as shown in Figure M-15.

Figure M-15: CAR-15 Heavy Summer Lowest Feeder Voltage Variation

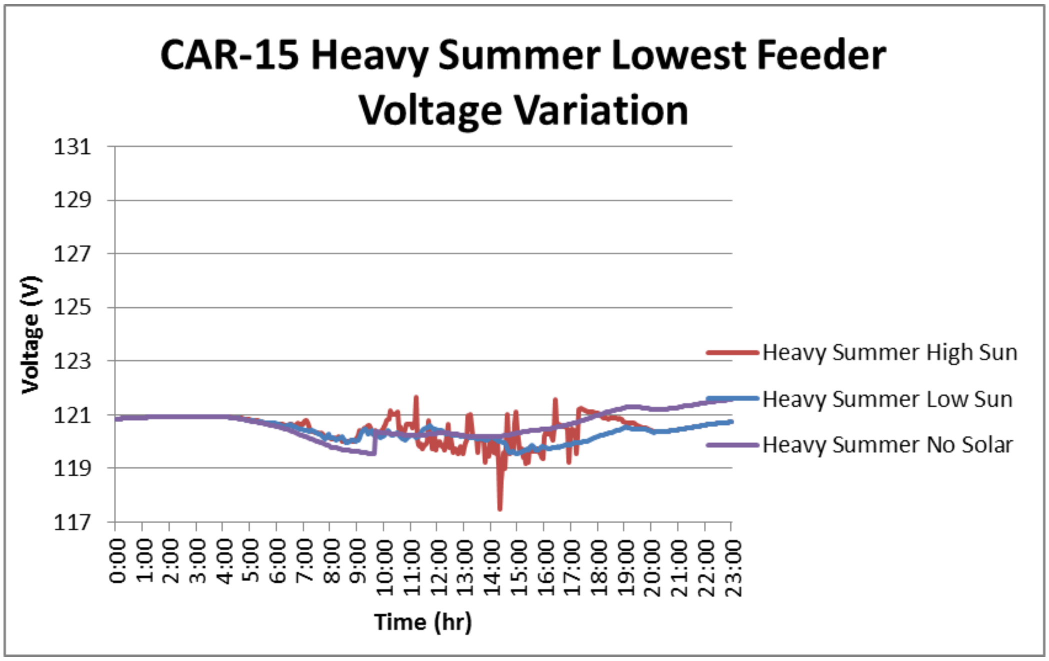
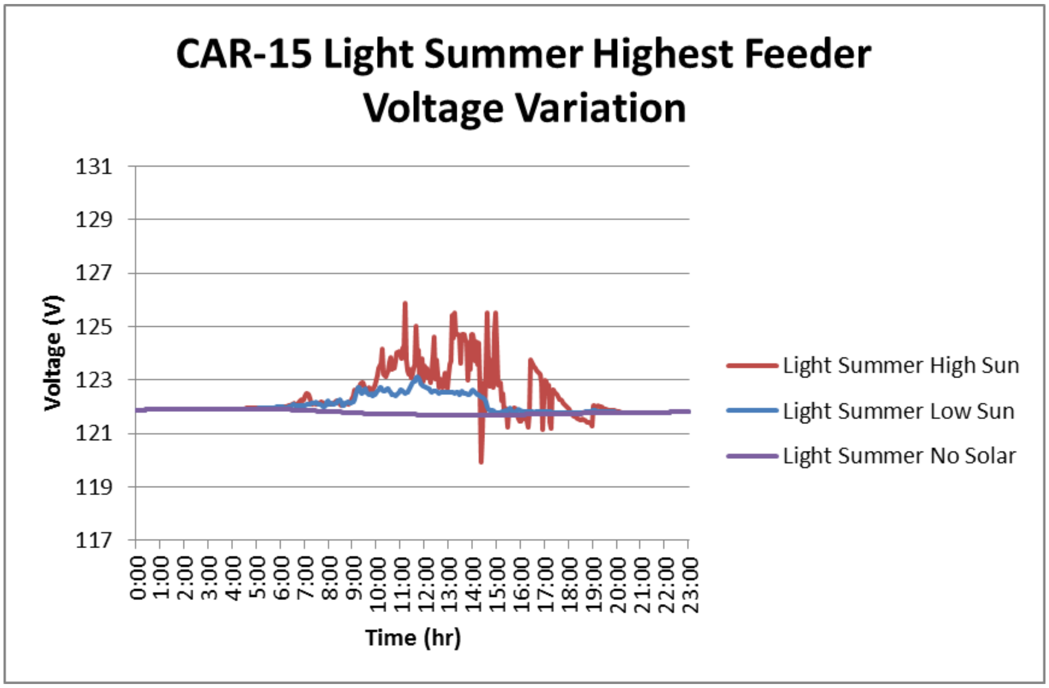


Figure M-16: CAR-15 Light Summer Highest Feeder Voltage Variation



On UHL-21, Figure M-17 shows that distributed solar generation does not help increase the minimum voltage on the circuit during heavy summer loading. Figure M-18 shows that it can cause some customers to receive much higher voltages than allowed during periods of high solar generation.

Figure M-17: UHL-21 Heavy Summer Lowest Feeder Voltage Variation

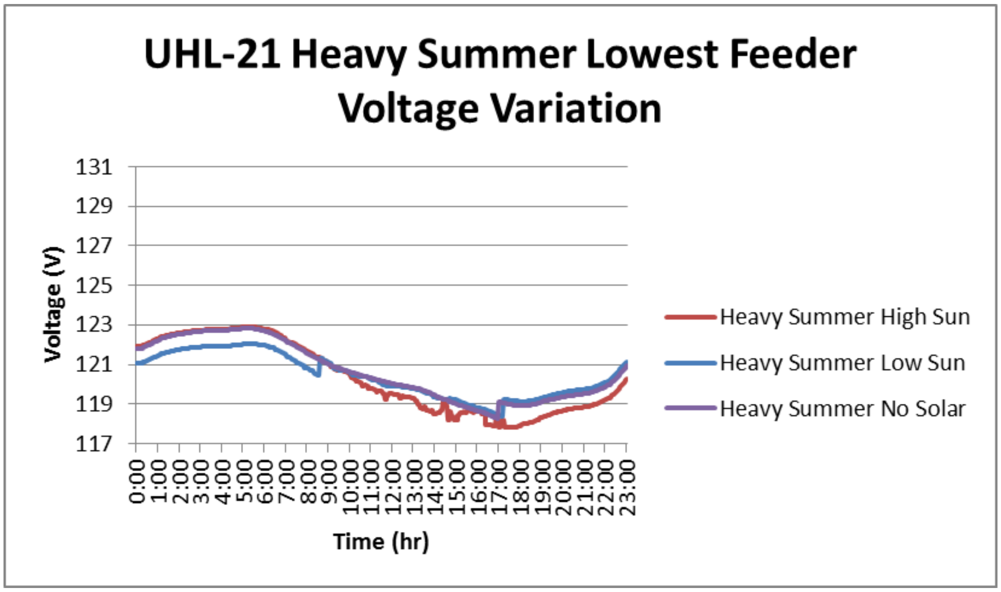
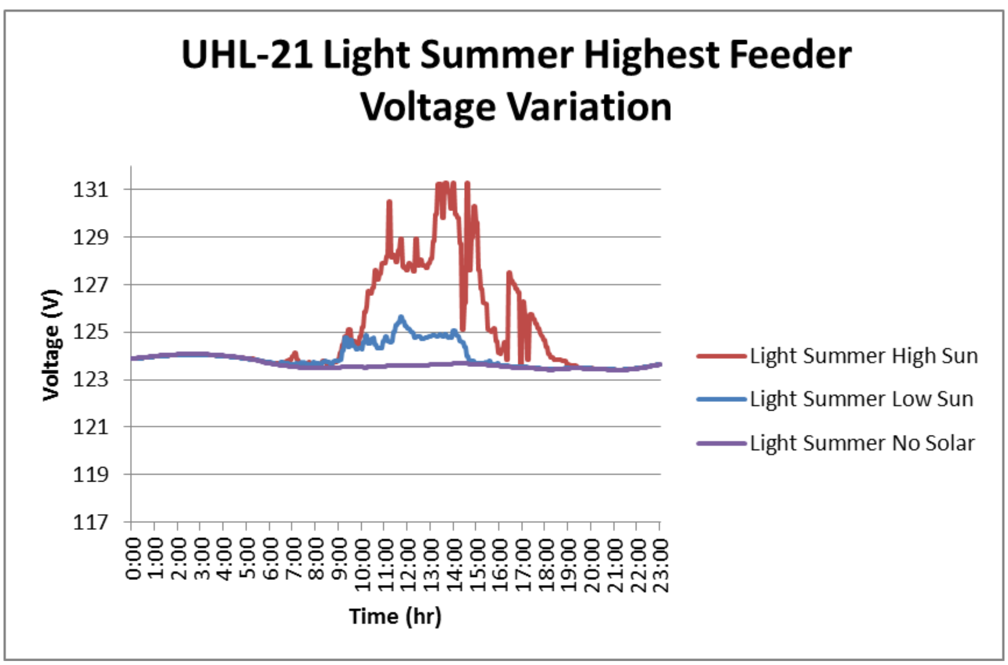
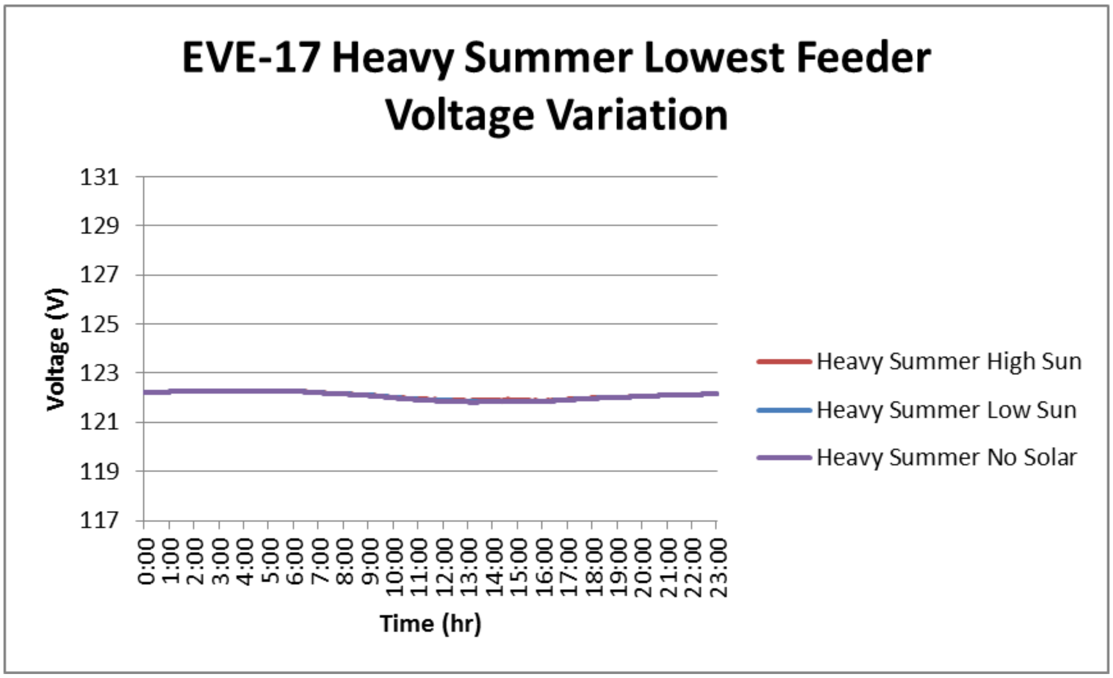


Figure M-18: UHL-21 Light Summer Highest Feeder Voltage Variation



EVE-17 is the circuit that serves only three commercial buildings in Redmond, so it has only 9 percent PV potential penetration. Figure M-19 shows that EVE-17 experiences a voltage increase of only 0.057 percent (unnoticeable on the same scale as the other charts), compared to 3.4 percent in the CAR-15 circuit. The highest feeder voltage was constant because the potential solar penetration was not significant enough to raise the voltage above the substation voltage on any section of the circuit, therefore it is not shown. Similarly, WIN-16 did not have a high enough potential solar generation to noticeably impact circuit voltages; it is also not shown.

Figure M-19: EVE-17 Heavy Summer Lowest Feeder Voltage Variation



Peak Demand. Meeting peak demand is a particularly important responsibility, so we wanted to know if distributed solar PV generation can contribute to meeting that need. In the charts below, the purple line represents the daily demand curve for a circuit in its peak demand season. The space between the purple line and the red line represents the reduction in demand that is produced by solar PV generation on high sun days. Only on EVE-17 does solar PV contribute to meeting peak need.

CAR-15, with 76 percent commercial loads, has a generally flat load once everything is "turned on." Solar generation contributes to meeting need during midday, but does not reduce the peak need in the morning.

Figure M-20: CAR-15 Winter Peak PV Effects

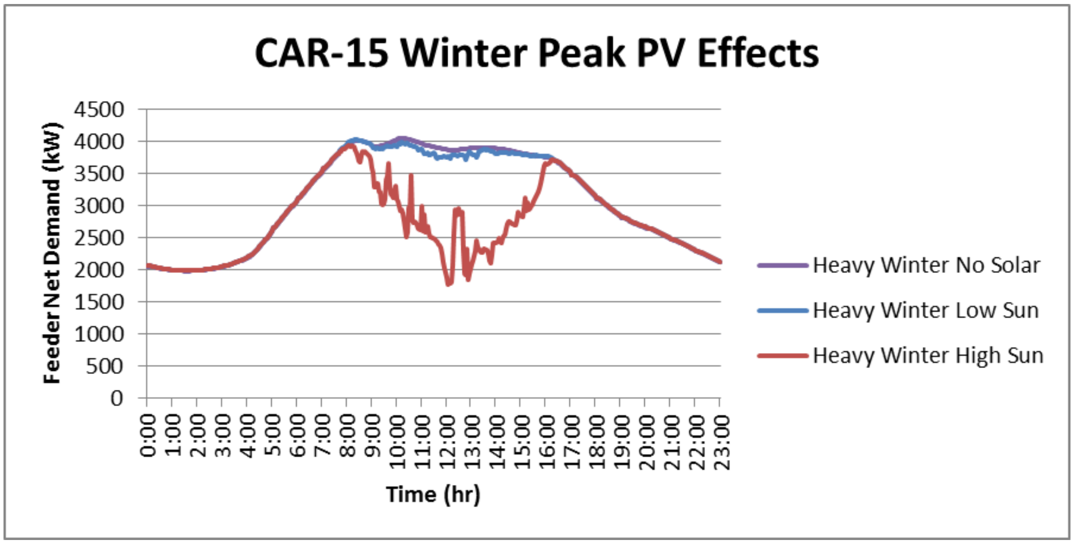


Figure M-21 shows that the winter morning peak on WIN-16 cannot be lowered by additional solar power, although it contributes to meeting need at midday.

Figure M-21: WIN-16 Winter Peak PV Effects

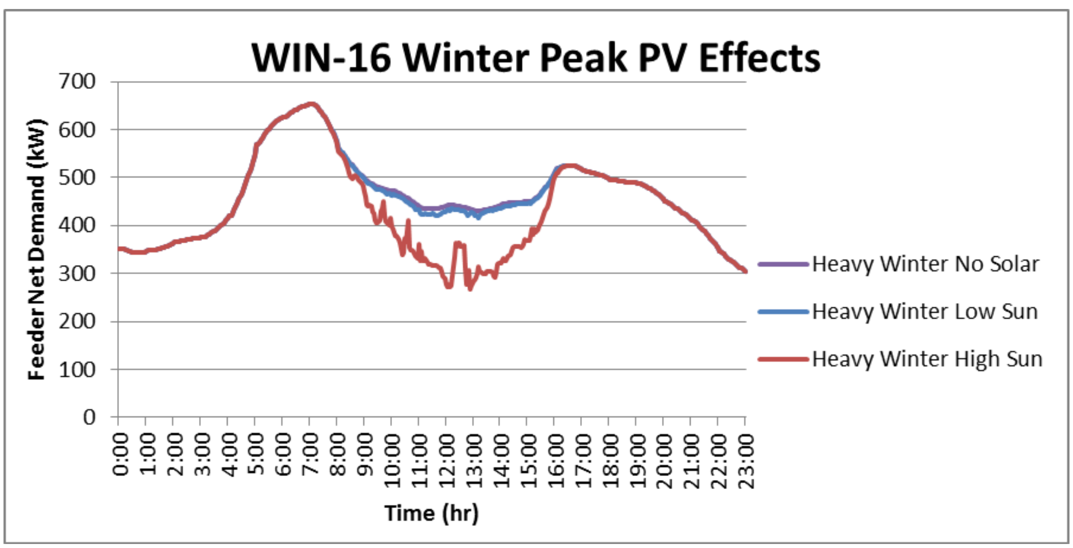


Figure M-22 shows that the evening winter peak on circuit UHL-21 is also not positively affected by solar power; however there are energy savings in mid-day on high sun days.

Figure M-22: UHL-21 Winter Peak PV Effects

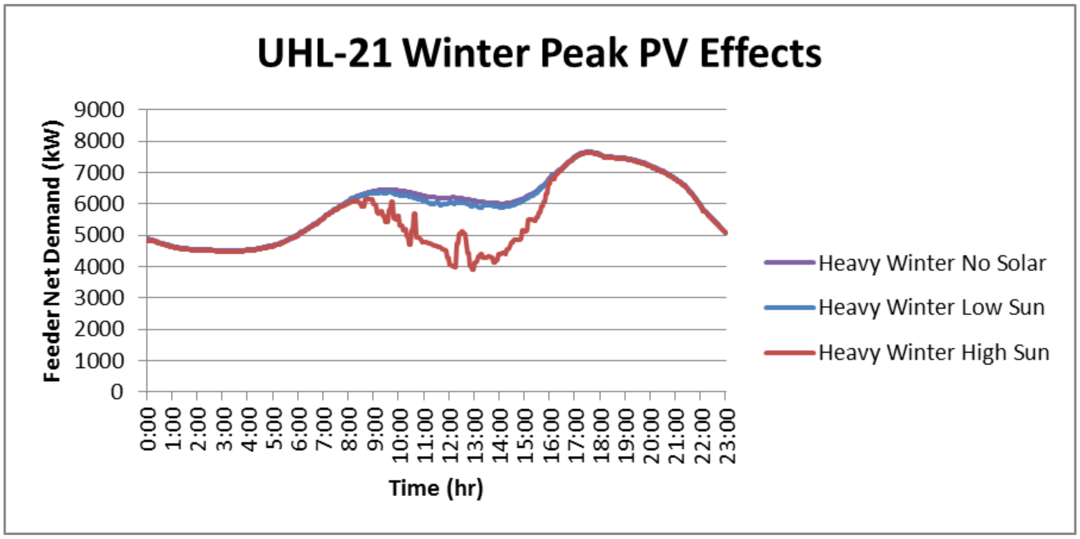
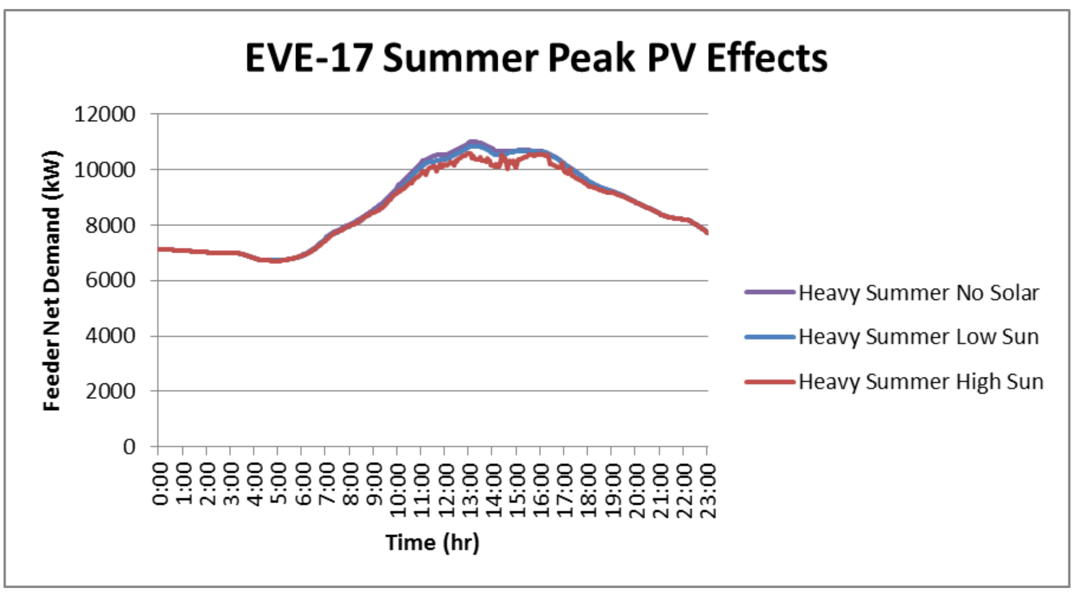


Figure M-23 shows EVE-17, the summer peaking circuit that serves business offices with lots of lighting, computers and air conditioning. On a high sun day, solar power can reduce peak load on this circuit.

Figure M-23: Eve-17 Summer Peak PV Effects



Line Losses. Line losses include all the electric power transmitted on a line but not delivered to the other side. They increase in proportion with the square of the current flowing through the line, so efficiency is higher when less electricity is flowing. When large amounts of solar PV flow back onto the grid, the amount of electricity can be much more than normal, leading to greater line losses.

CAR-15 and UHL-21, below, show significant losses due to the over-supply of PV generation. When compared to the potential PV production in Figures M-4, 6, 8 and 10, these losses range from 25 percent to 30 percent. WIN-16 has losses up to 10 percent. In comparison, the average line loss across PSE's entire transportation and delivery system is approximately 8 percent. While line losses do not cause problems for customers and their appliances, they are an unnecessary waste of energy. Measures to limit line losses include increasing the size of conductors or using smart inverters to limit the amount of energy that goes onto the grid.

Figure M-24: CAR-15 Heavy Summer Line Losses

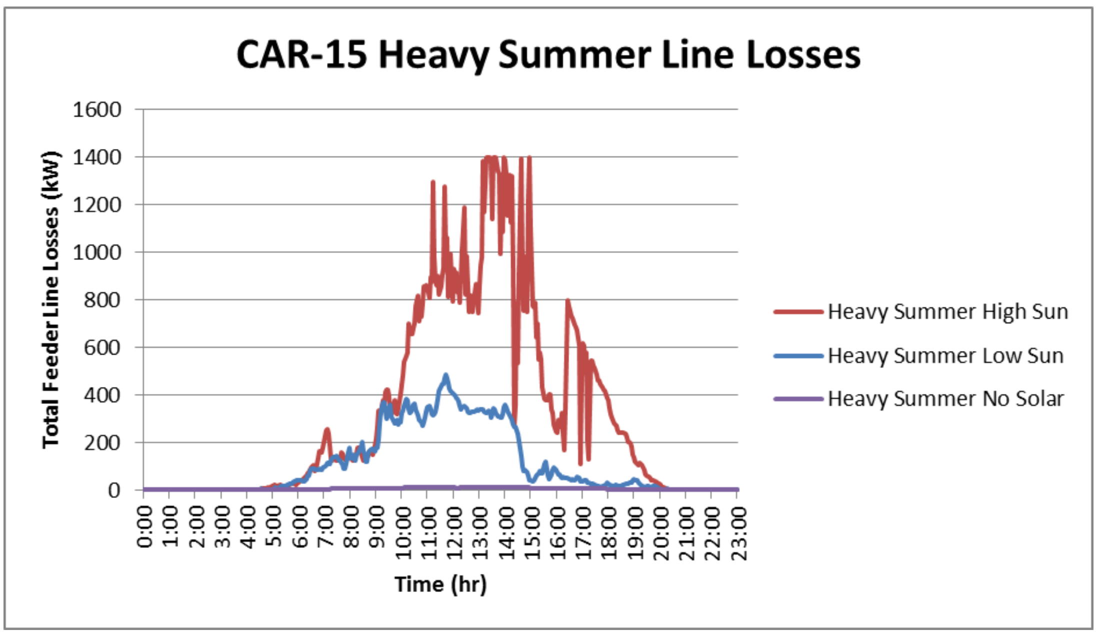


Figure M-25: UHL-21 Heavy Summer Line Losses

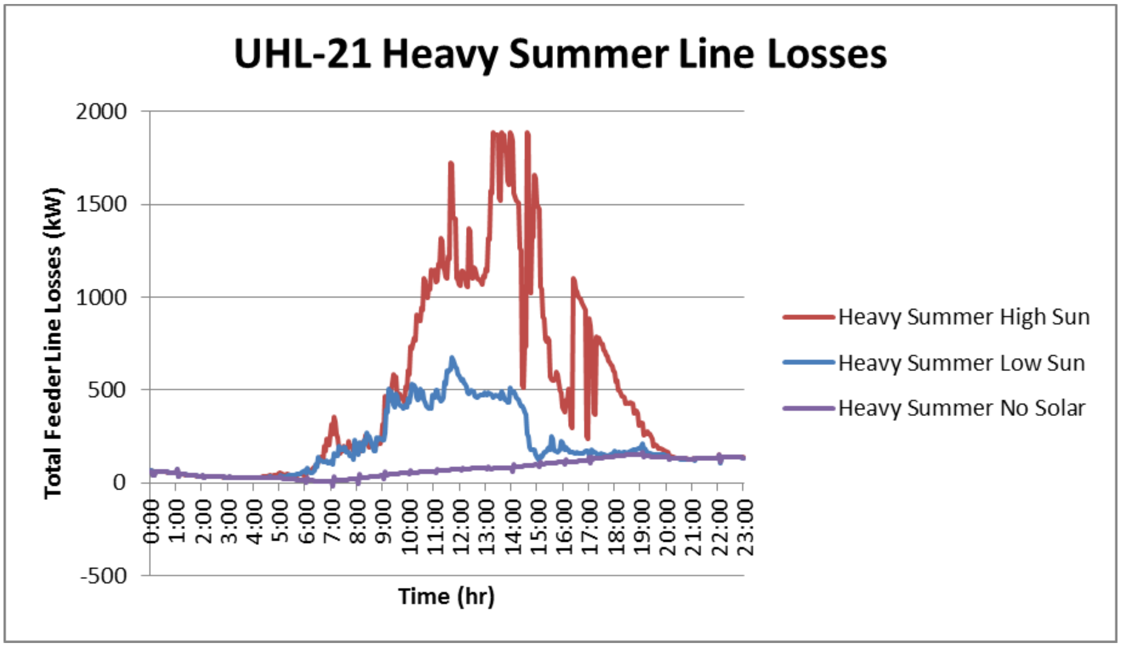
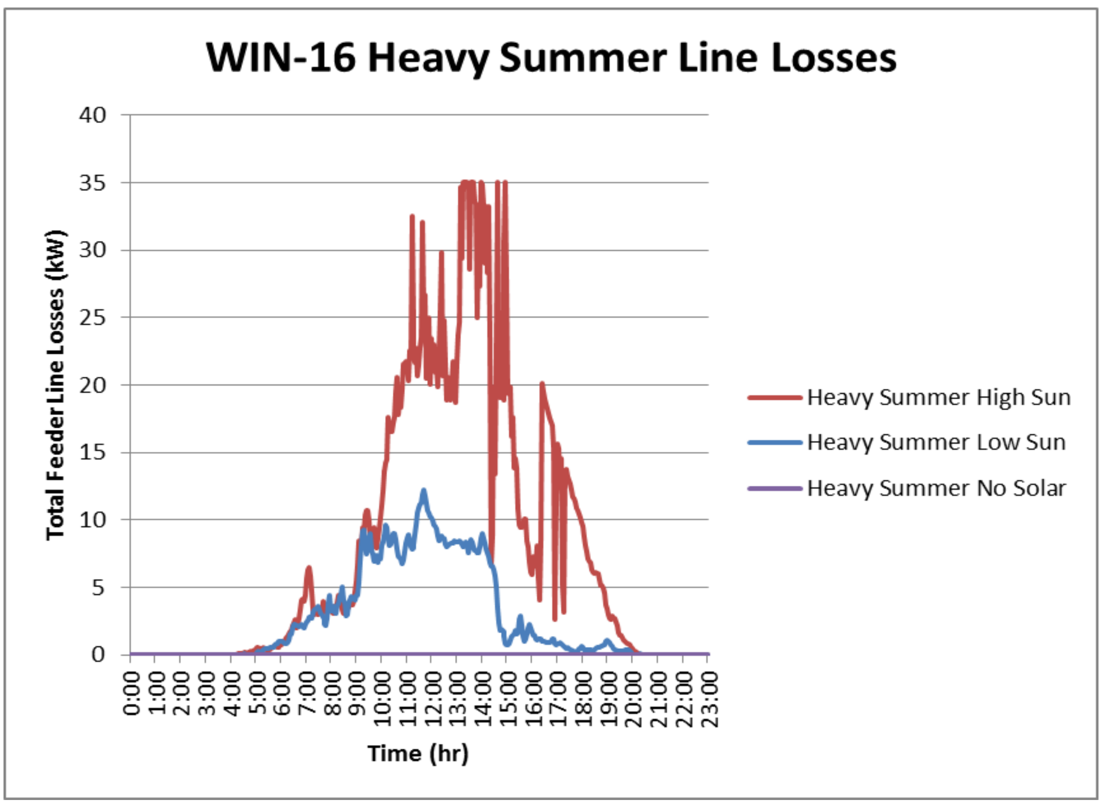
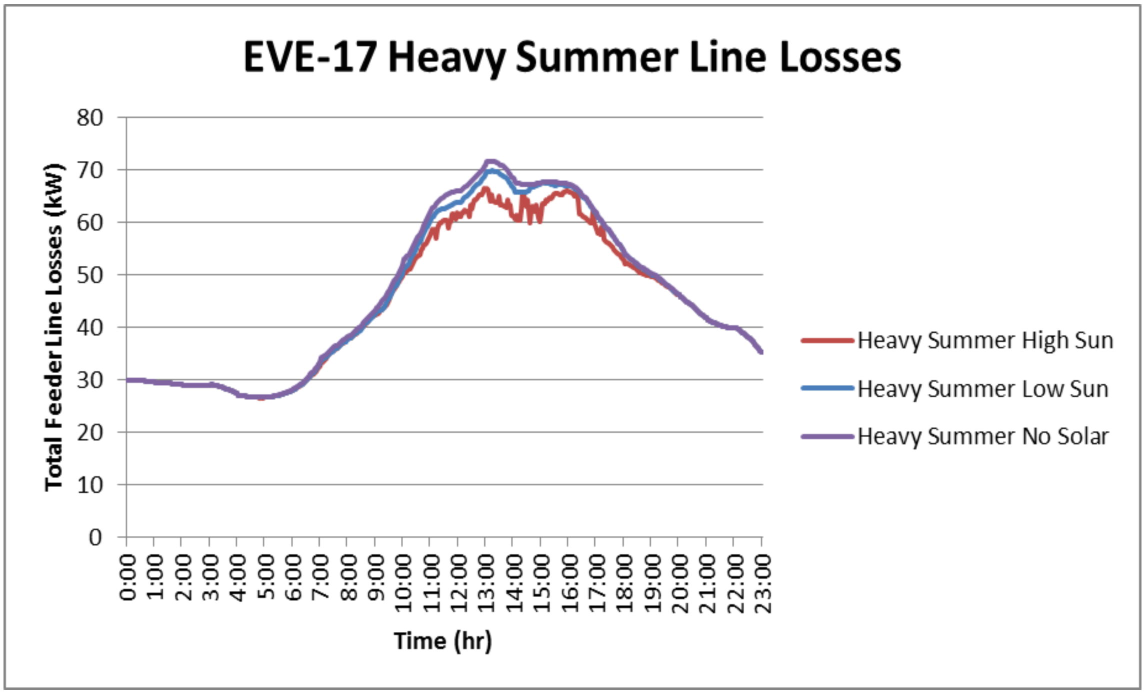


Figure M-26: WIN-16 Heavy Summer Line Losses



EVE-17 provides a very different result: Here, PV can reduce line losses. In this case for the heavy summer load with high sun the daily line loss is reduced by 3.5 percent. This occurred because the solar generation is less than the power consumed by the customer at all times.

Figure M-27: EVE-17 Heavy Summer Line Losses



Summary

As a result of this analysis, the following conclusions were reached. For quick reference, the figures that support each conclusion are referenced in brackets following each bullet.

CUSTOMER VOLTAGE

- Longer feeders are more difficult to keep within voltage limits when serving large numbers of distributed solar customers. [M-18]
- Shorter feeders have more rapidly changing voltages when serving high penetrations of distributed solar customers, but not by enough for customers to be served a voltage outside of allowable limits. [M-16]

LINE LOSSES

- Feeders with load that is distributed across a large area are more likely to see significantly higher line losses with high amounts of distributed solar. [M-24, M-25]
- Solar customers that use more load than they can generate reduce line losses on a circuit. [M-27]

FEEDER DEMAND

- Using realistic assumptions about maximum levels of solar penetration for western Washington, it is possible that some feeders could generate significantly more power than they consume. [M-11, M-12, M-13]
- Demand varies significantly from minute to minute when the volatility of customer load is combined with the volatility of distributed solar generation. [M-11, M-12, M-13]
- Even in the winter, or on cloudy summer days, a significant amount of solar power can be produced by solar customers in western Washington. [M-4, M-6, M-8, M-10]
- Peak demand in winter is generally not reduced by large penetrations of distributed solar generation, because nearly all PSE feeders peak in the winter in either the early morning or evening when there isn't enough sunlight to produce a significant amount of solar power. [M-20, M-21, M-22]
- For feeders that peak in the summer, peak demand is reduced by distributed solar generation. [M-23]

DISTRIBUTED PHOTOVOLTAIC TECHNICAL AND MARKET POTENTIAL

The Cadmus report on this study appears on the following pages.

CADMUS

To: Gurvinder Singh, Tom MacLean; Puget Sound Energy
From: Shawn Shaw, Lakin Garth
RE: PSE IRP Distributed PV Technical and Market Potential Study
Date: March 19, 2015

Introduction

This memorandum outlines the approach used, and key results obtained, in our analysis of Puget Sound Energy's (PSE's) photovoltaic (PV) technical and market potential. The preliminary results presented in this memorandum, unless stated otherwise, apply to the 2016-2035 study period and may not reflect cumulative totals that include PV installations from 2009-2015.

Key Findings

We have analyzed the technical and market potential for PV in PSE's service territory for the 20 year period from 2016-2035. Over this period, we expect PSE's technical potential to be 14,037 MW (nameplate) for rooftop solar PV, based on the feasible roof area available and current projections for array power density, as discussed below. This technical potential reflects the maximum amount of rooftop PV that could be installed in PSE's service territory, regardless of economic or policy considerations. This reflects an upper bound on PV installed capacity and PSE will likely install a much smaller amount of PV, after accounting for market factors.

These factors, which reflect economic, technology acceptance, and policy considerations, are included in the market potential. For PSE's service territory, over the study period, we have calculated a cumulative market potential of 3 MW under our Baseline scenario. Under a Best Case scenario, reflecting a suite of favorable policies, PSE's market potential is 309 MW by 2035. The low market potential for the Baseline scenario is driven by expiration of several important incentives during the study period, including the investment tax credit (ITC), Renewable Energy System Cost Recovery Program (CRP), and the State Sales Tax Exemption. Extending either the ITC or, in particular, the CRP will have a substantial impact on the market and increase PSE's market potential. Should nothing change with regard to current PV policies affecting PSE customers, there will likely be a substantial decline in installation rates, resulting in essentially zero growth in installed capacity from 2016 through 2030. Declining costs of PV will begin to encourage some growth after 2030 but, in the interim, the PV industry in Washington will likely experience substantial decline compared to present levels.

Technical Potential Methods and Results

The technical potential of rooftop PV is a function of available roof area suitable for PV installation and the power density of ever-more efficient PV arrays.

Available Roof Area

We calculated the available roof area based on building square footage, obtained from the Commercial Buildings Energy Consumption Survey (CBECS) and the residential data is PSE's 2010 Residential Appliance Saturation Survey (RASS) data and an assumed number of floors per building type. By dividing the overall square footage of each building category (single family residential, K-12 school, etc.) by the number of floors, we estimated the roof area available for each type of building, as shown in Table 1 (commercial) and Table 2 (residential). The estimated number of floors is an average, based on the number of floors reported by facility owners participating in the survey, rather than archetypal examples of each building type.

Table 1: Available Area by Building Type (Commercial)

Building Type	Building Floor Area (ft^2)	Estimated Floors	Roof Area (ft^2)	Customer Counts
Dry Goods Retail	11,500	1.22	9,426	12,210
Grocery	32,000	1.18	27,119	1,870
Hospital	17,000	1.65	10,303	6,857
Hotel/Motel	17,500	2.74	6,387	1,897
Office	15,500	1.82	8,516	44,542
Other	12,000	1.22	9,836	40,576
Restaurant	3,500	1.27	2,756	5,114
School	53,500	1.15	46,522	2,238
University	56,000	2.57	21,790	779
Warehouse	60,500	1.14	53,070	5,413
Total Commercial	**279,000**	**1.60**	**174,812**	**121,494**

Table 2: Available Roof Area by Building Type (Residential)

Building Type	Building Floor Area (ft2)	Estimated Floors	Roof Area (ft2)	Customer counts
Multi-Family	1,300	2.00	650	207,591
Manufactured	1,570	1.00	1,570	71,778
Single Family	1,921	2.00	961	681,994

Adjusted Available Area

The raw available area cannot be used directly to estimate technical potential because not every roof is suitable for PV. To account for factors such as unsuitable roof orientation or roof space that is not suitable for PV, we made several engineering assumptions. The assumptions used in our analysis are summarized below, in Table 3. While most of these assumptions are the same as those used in our 2008 analysis, we updated the analysis to include a reduction in available roof area due to Washington's recent adoption of the 2012 International Fire Code (IFC) Article 605.11.3, which requires minimum roof area be maintained for safe access by emergency personnel. The addendum was effective on April 1st, 2014, and requires that PV arrays "shall be located no higher than 18 inches (457 mm) below the ridge in order to allow for fire department rooftop operations". Though this is less stringent than similar codes adopted in California and other jurisdictions, it nevertheless limits the available roof area for installing PV modules.[1]

Table 3: Adjusted Available Area Assumptions and Inputs

Assumption	Value in Previous Analysis
Roof Pitch (Manufactured/Single Family)	4/12 pitch, equal to 18.4°
Roof Pitch (Commercial/Multifamily)	Flat roof, 0° pitch
Usable Roof Orientation	25% each for East, South, and West facing roofs, for a total of 75% for pitched roofs and 100% for flat roofs. Only 50% of pitched roof area is correctly oriented, however, to account for the north side of south-facing roofs.
Roof Area Available due to Obstructions	70%-Multifamily, 85%-Single-family/manufactured, 80%-commercial
Roof Area Unsuitable due to Shading/Technical Feasibility Restrictions	50%-Residential, 15%-commercial
Roof Area Unavailable due to adoption of IFC 605.11.3	4-6% (residential only, varies by building type)
Overall Roof Area Available	**16%-Single-family, 16.2%-Manufactured, 32.9%-Multifamily, 65%-Commercial**

Power Density

After determining the available area for PV installation, it is important to then understand how much power can be generated on a per unit area basis. With constant improvements in PV cell and module efficiency, power densities are likely to increase by 20%, or more, over the study period.

Table 4: Power Density Assumptions and Inputs

Assumption/Input	Value in Previous Analysis
Module Power Density	15.5 peak Watts (Wp)/ft^2, based on the five most commonly installed PV modules in Washington
Array Inactive Area	25% of array space devoted to wiring, inter-module spacing, and similar non-collecting surfaces
Annual Increase in Module Efficiency	2.1% per year (equivalent to roughly 0.3 points increase in module efficiency per year) based on US DOE module efficiency projections.
Overall Power Density	**12.9 Wp/ft^2 in 2016, increasing by 2.1% per year**

[1] Washington State Department of Enterprise Services, State Building Code (https://fortress.wa.gov/ga/apps/sbcc/Page.aspx?nid=14)

Electricity Generation

PV direct current (DC) capacity is a product of the available roof area and the power density. We converted the PV capacity (kW) into annualized electricity (kWh) generation. In order to estimate annual energy savings PSE provided a value of 1,000 kWh per kW_{DC} installed, based on historical performance of net-metered PV systems in PSE territory. Though this is method would poorly reflect any single PV project's expected annual generation, it is a reasonable approximation of the mix of PV system designs currently operating in PSE's territory.

Technical Potential Results

Based on the analysis described in the previous sections, we estimate that PSE's total technical potential for PV installed from 2016-2035 is 14,037 MW. The majority (84%) of this technical potential is in the commercial sector, with 16% from the residential sector. If installed, this amount of PV would generate approximately 14,037 GWh annually. The predominance of the potential in the commercial sector is driven by the substantially larger available roof area in the commercial sector and the greater portion of roof area suitable for the installation of solar PV systems.

Market Potential

After calculating the technical potential, which provides a likely upper bound on PV capacity growth, we considered relevant market factors to determine likely PV growth for PSE planning purposes. In order to assess market potential, we first examined the customer economics of PV in PSE's service territory, in terms of simple payback. We then used this metric to subsequently calculate market potential for several policy-based scenarios.

Customer Payback

Simple payback is a metric commonly used in the sale of energy efficiency and renewable energy technologies. Though it is a simplistic calculation, it is intuitively easy for customers to understand and is a key factor in their financial decision-making process. For this analysis, we have calculated simple payback using Equation 1.

Equation 1: Annualized Simple Payback

$$ASP = \frac{Net\ Costs\ (after\ incentives)}{Annual\ Energy\ Savings + CRP\ Payments}$$

Though Equation 1 is conceptually simple, the mix of incentives and cost projections added complexity to the calculations. For purposes of this analysis, we used the assumptions described in Table 5 (residential costs), Table 6 (residential revenue), Table 7 (commercial costs), and Table 8 (commercial revenue).

Table 5: Residential PV Net Cost Assumptions

Assumption	Value	Source
System Cost	$4.7/W_DC in 2013	Tracking the Sun VII Report, Lawrence Berkley National Laboratory (2014)
Annual Cost Reduction	11%-3%	See discussion of cost assumptions, below
System Capacity	5kW	Assumption
Investment Tax Credit (ITC) ends 12/31/2016	30%	Database of State Incentives for Renewable Energy (DSIRE)
State Sales Tax Exemption	6.5%	Database of State Incentives for Renewable Energy (DSIRE)

Table 6: Residential PV Revenue Assumptions

Assumption	Value	Source
Net Metering Rate	$0.0853/kWh	2012
Utility Rate Escalation	3%	EIA Electric Power Annual (rate change 2012-2013)
Annual Generation	1,000 kWh/kW_DC	Provided by PSE staff
CRP Incentive Rate[2]	$0.39	Average of incentive claim requests, provided by Washington State University via email[3]

Table 7: Commercial PV Net Cost Assumptions

Assumption	Value	Source
System Cost	$4.30/W_DC in 2013	Tracking the Sun VII Report, Lawrence Berkley National Laboratory (2014)
Annual Cost Reduction	11%-3%	See discussion of cost assumptions, below
System Capacity	100kW	Assumption
Investment Tax Credit (ITC)	30%	Database of State Incentives for Renewable Energy (DSIRE)
Investment Tax Credit (ITC) after 12/31/2016	10%	Database of State Incentives for Renewable Energy (DSIRE)
State Sales Tax Exemption	6.5%[4]	Database of State Incentives for Renewable Energy (DSIRE)

[2] Note that our analysis capped payments at $5,000 per year, regardless of incentive rate

[3] Note that this is a statewide figure and is assumed to be applicable to PSE customers

[4] Note that this exemption also includes local sales taxes. To be conservative, we have only included the baseline state sales tax rate in this analysis but, anecdotally, expect that this number may be closer to 10% when all local taxes are included. A survey of local sales tax rates was not included in this study.

Table 8: Commercial PV Revenue Assumptions

Assumption	Value	Source
Net Metering Rate	\$0.0768/kWh	2012
Utility Rate Escalation	2.5%	EIA Electric Power Annual (rate change 2012-2013)
Annual Generation	1,000 kWh/kW_{DC}	Provided by PSE staff
CRP Incentive Rate	\$0.39	Average of incentive claim requests, provided by Washington State University via email. Note that the CRP is capped at \$5,000 per year.

We did not include operations and maintenance (O&M) costs in the simple payback calculation because these costs are rarely (and certainly not consistently) reflected in the PV system sales process. As the market penetration model uses simple payback as a means of predicting customer purchase decisions and O&M costs occur after the purchase is made, we deliberately excluded these costs from the analysis.

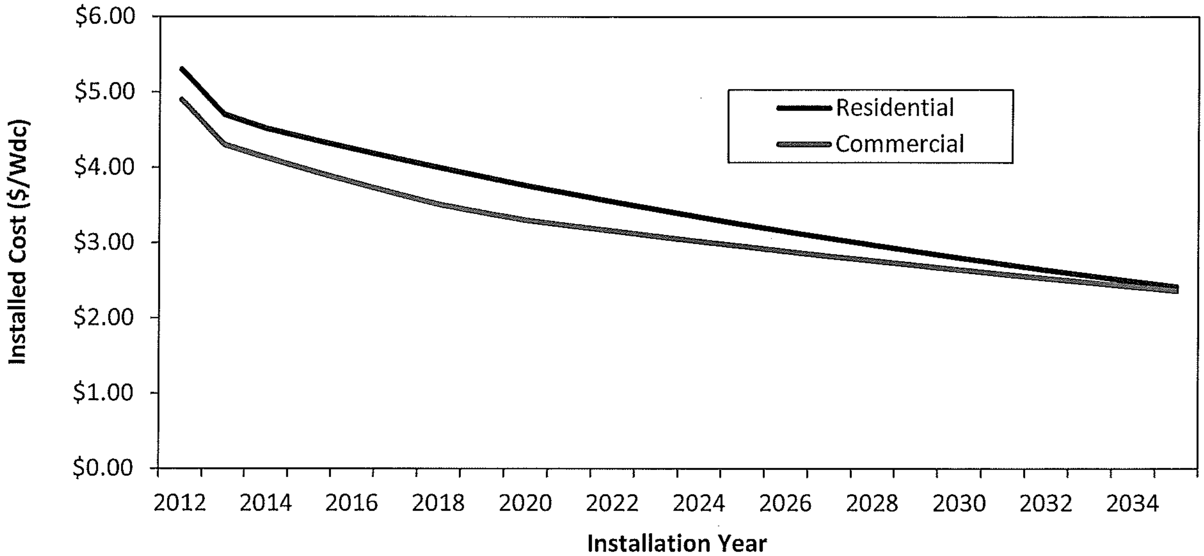
For purposes of this analysis, we assumed that the net system cost, after applying relevant incentives, was paid on a cash basis and, therefore, have not included cost of capital in the simple payback calculation.

Installed Costs

We compiled assumptions for residential and commercial installed cost (\$/W) from several sources to arrive at a reasonable projection through the study period. We used the Tracking the Sun VII 2014 Report[5] for the starting point, with the 2013 installed costs \$4.90/W and \$4.3/W respectively for residential and commercial installations. The IREC's 2012 and 2013 Updates & Trends Annual Reports[6] gave supporting evidence of the trends in the past years. We looked to the SunShot Vision Study[7] – February 2012 and the U.S. Energy Information Administration's (EIA's) Annual Energy Outlook 2014[8] reports to project future price trends. The SunShot report compared the Sunshot goal (\$1.50/W for residential and \$1.25/W for commercial in 2020) to a reference price of what would occur if SunShot initiatives were not followed. These prices were \$3.78/W and \$3.36/W, respectively. We used the reference prices for the 2020 installed cost as a benchmark, varying the annual price decrease to meet these benchmark price points in 2020. From 2021-2035, we assumed a decrease of 2.9% (residential) and 2.2% (commercial) for a final installed cost of \$2.42/W for residential and \$2.36/W for commercial installations in 2035 as shown in Figure 1 . Given that the Sunshot report reference cases are a conservative estimate of future pricing, it is likely that installed costs will fall faster than predicted, which would result in a correspondingly higher market potential.

[5] Tracking the Sun VII 2014: http://emp.lbl.gov/sites/all/files/lbnl-6808e_0.pdf
[6] IREC's 2012 and 2013 Updates & Trends Annual Reports: http://www.irecusa.org/publications/
[7] SunShot Vision Study – February 2012: http://www1.eere.energy.gov/solar/pdfs/47927.pdf
[8] U.S. Energy Information Administration's (EIA's) Annual Energy Outlook 2014 (AEO2014): http://www.eia.gov/forecasts/aeo/

Figure 1: Projected Installed Cost of PV Through 2035[9]



Market Penetration Rates

Predicting what portion of technically feasible sites will actually install PV systems during the study period is a complex process that is driven by many policy, economic, and technical factors beyond PSE's direct control. For this analysis, we have used a variant on the Bass Diffusion Model, used in similar market potential studies in other states[10]. This model estimates market penetration, as a percent, as a function of customer payback. Prior to being applied to solar PV, this approach has been applied in many energy efficiency studies and it provides a convenient method for modeling a variety of policy and market scenarios, as most of these scenarios have an influence on the simple payback and, as a result, the market penetration calculation. The curve used in this analysis is shown in Equation 2.

Equation 2: PV Market Penetration Model

$$MP = e^{-0.3*ASP}$$

Where MP is Market Penetration (%) and ASP is Annualized Simple Payback (the time, in years, it takes for the energy savings from the PV project to completely offset the undiscounted installation cost). For this analysis, we calculated ASP from the customer perspective, including all relevant incentives.

As with any model, it is always useful to check predictions against historical data to provide confidence in the model's ability to predict future outcomes. In this case, PSE has both annual technical potential and installed capacity (MW) data for 2009-2013. Using this historical data, and our projections of customer payback in these past years, we calculated a retrospective market penetration rate and compared it to the results of Equation 2. While both curves are exponential in nature, the historical

[9] The projected costs are expressed in nominal dollars per Watt.
[10] Distributed Renewable Energy Operating Impacts and Valuations Study, R.W. Beck 2009

data[11] indicates a much steeper increase in market penetration as payback time decreases, with a somewhat lower likelihood to install PV when simple payback exceeds 7 years, as shown in Figure 2. The reason for the differences between the modeled and historical market penetration rates is not entirely clear from the data available. One possible cause is that Equation 2 aggregates a wide variety of customer preferences- such as environmental awareness, distribution of market actor types (e.g., early adopter), and sensitivity to simple payback time-into a single multiplier (-0.3) that may not accurately represent the Washington market. As a result, we used a modified version of Equation 2 to calculate market potential for this study, based on the historical market penetration rates seen over the past four years in PSE's service territory (Equation 3). While this adjusted model is very similar to Equation 2 at long payback periods, the model presented in Equation 3 is more conservative for shorter payback periods and is likely a better fit for predicting long-term market potential in Washington.

As a final note, due to the small population of commercial projects represented in the historical data, we have applied the same market penetration rates to both commercial and residential installations. In reality, these two market segments make purchasing decisions differently and may be better represented with two different market penetration curves. However, there is not sufficient data to generate a market penetration curve for commercial installations at this time.

Equation 3: Adjusted Market Penetration Rate Based on Historical Data

$$MP_{adj} = 0.786e^{-0.425*ASP}$$

[11] Historical data was obtained from net-metering application data presented by Jake Wade in a January 2014 PowerPoint presentation. The installed capacity was given for the years 2009-2013, with assumptions applied as to the percentage of residential PV.

Figure 2: Historical and Modeled Market Penetration (2009-2013)

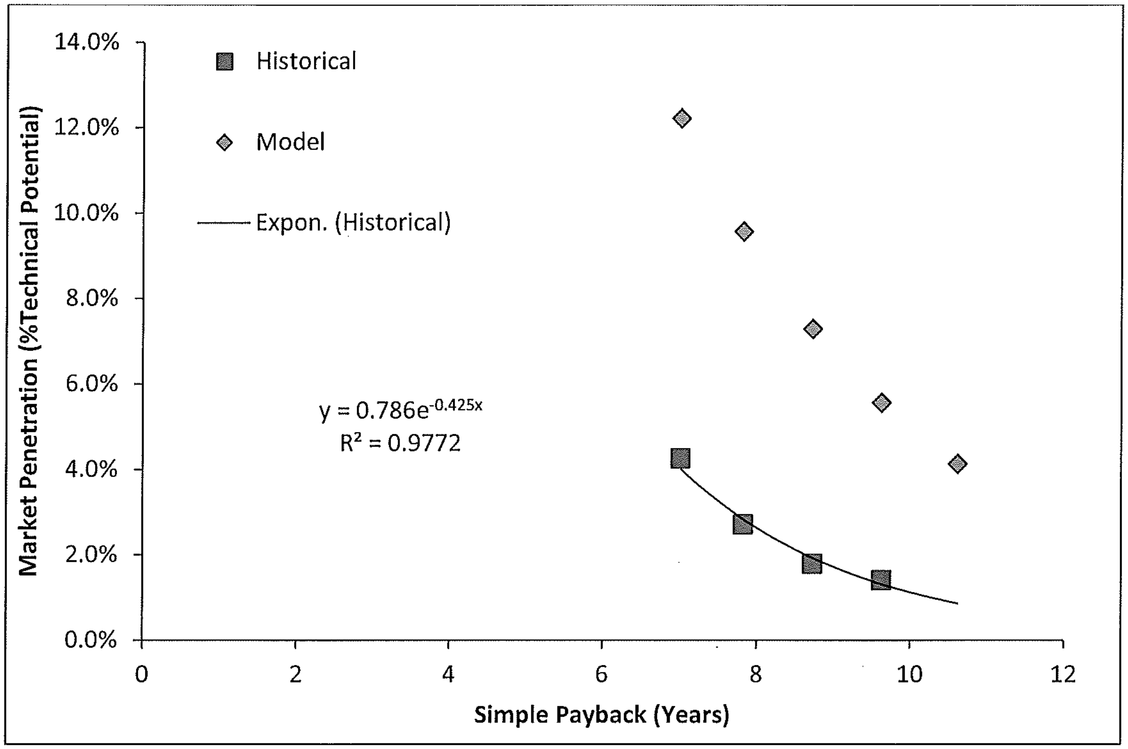
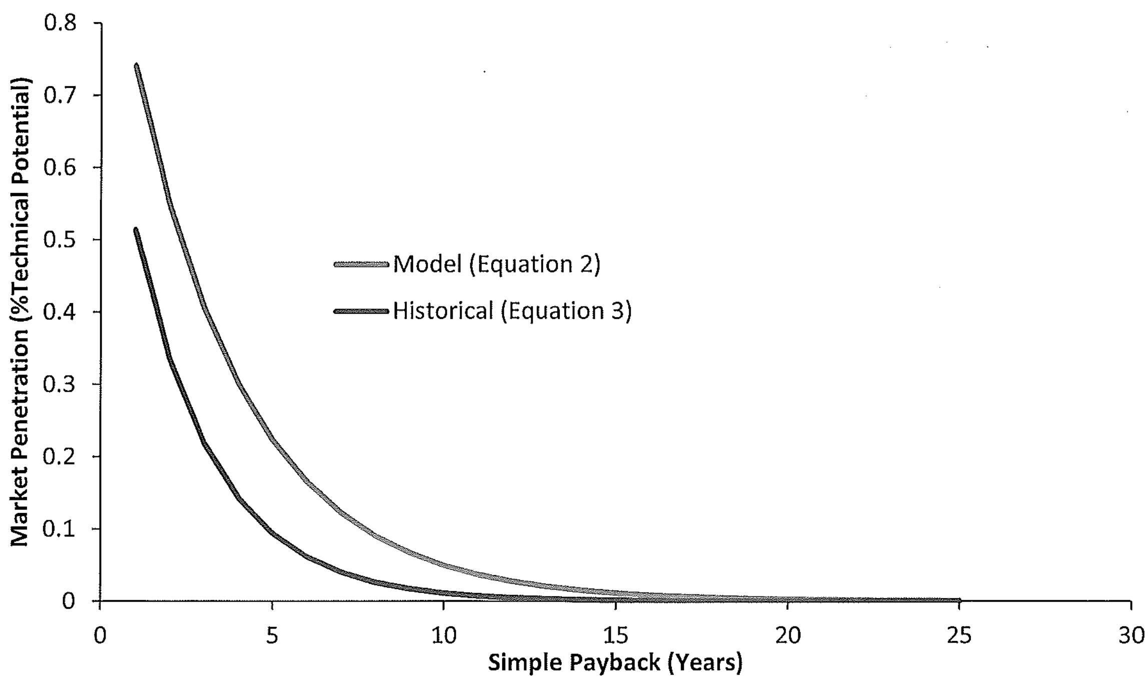


Figure 3: Impact of Model Selection on Market Penetration Rates



Scenario Analysis

The future of the PV market is heavily influenced by policy and incentive decisions. In order to model the influence of these policy changes on PSE's PV market potential, we have developed a series of scenarios reflecting the impact of policy changes on customer payback and, by extension, market potential. These scenarios used the historically based model pictured in Figure 2. The scenarios are summarized below.

Baseline Scenario

In the Baseline Scenario we assume that all existing policies and incentives remain in effect, as currently written, with no changes. This includes several key policies:

- Investment Tax Credit (ITC): The ITC provides a 30% tax credit for PV, expiring on 12/31/2016 for residential but reduced to 10% for commercial
- State Sales Tax Exemption: Solar PV equipment is currently exempt from a 6.5% Washington State Sales Tax. This benefit expires on 6/30/2018.
- Renewable Energy System Cost Recovery Program (CRP): The CRP provides a variable production-based incentive of up to $5,000 per year for PV systems. The incentive level ranges from $0.15/kWh to $0.54/kWh, depending on customer eligibility for a variety of incentive adders (e.g., for using equipment manufactured in Washington). This incentive is set to expire on 6/30/2020.
- Net Metering: PSE is limited to meet 0.5% of peak 1996 loads, or 22.3 MW from net-metered systems up to 100kW.

Extended ITC Scenario

In this scenario, we assume all incentives and policies are the same as the base scenario, except that the ITC is extended through the end of the study period at its current rate of 30%.

Extended CRP Scenario

In this scenario, we assume all incentives and policies are the same as the base scenario, except for the CRP is maintained at the current incentive level through the end of the study period, rather than expiring in 2020.

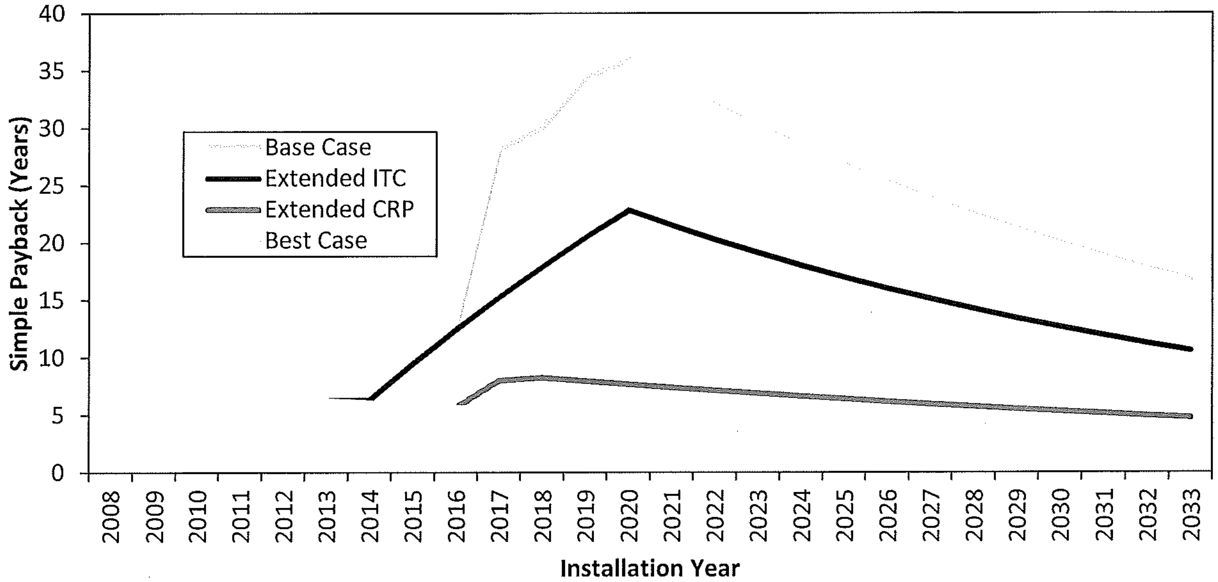
Best Case Scenario

The Best Case Scenario reflects the most favorable policy options of the other scenarios. This case includes the continuation of the CRP, and ITC (at 30%) as well as the State Sales Tax Exemption.

Market Potential Results

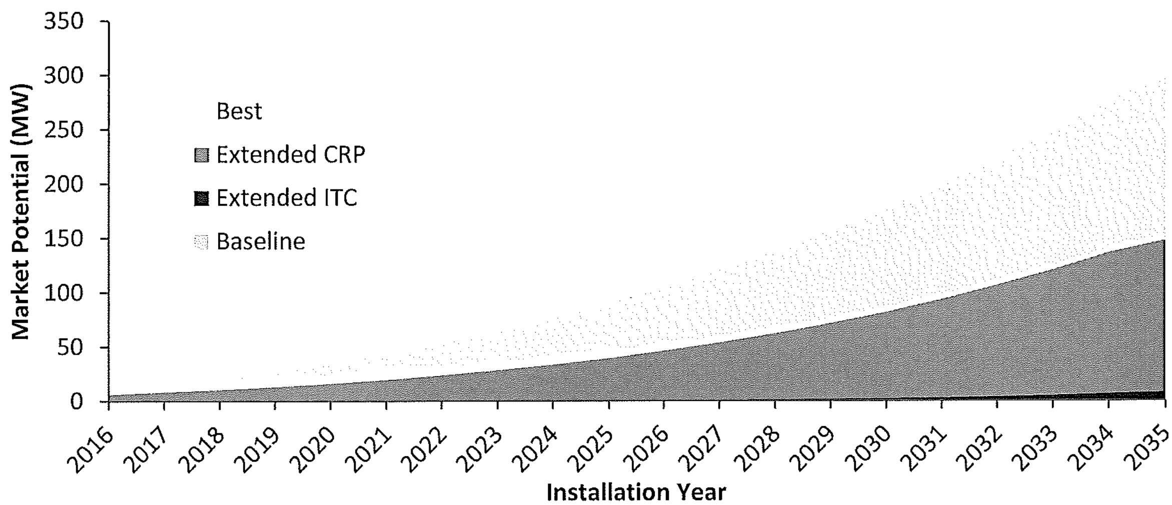
Unsurprisingly, the market potential for PV is heavily influenced by the scenarios described above. We have shown the impact of these scenario choices on expected customer payback (residential) in Figure 4. The expiration of several key incentives over the next few years, shown in the Baseline Scenario, will have a substantial impact on customer payback. For example a residential customer purchasing a PV system in 2014 might expect a simple payback of approximately 6 years, while a customer purchasing a PV system in 2020-after the expiration of the ITC and CRP incentives-could expect a simple payback of 36 years, despite falling costs of PV over the study period.

Figure 4: Residential PV Simple Payback Projections under Four Policy Scenarios



The high payback periods indicated will have a substantial impact on market penetration rates, with installations essentially coming to a halt beginning in 2017, as customers are faced with the declining value of the CRP and the expiration of the ITC simultaneously. As shown in Figure 5, PV market potential is essentially flat, with little growth beginning in 2016, under both the Baseline and Extended ITC scenarios. Though extending the ITC will provide a substantial benefit to the growth of PV compared with the Baseline scenario, by far the largest driver of customer economics (and market potential) is the CRP incentive. Extending the CRP incentive, even in a reduced form, is a key driver to further growth of the Washington PV industry.

Figure 5: Cumulative Residential PV Market Potential by Scenario



We have summarized the market potential results in Table 9. As discussed above, extending the CRP provides a substantial increase in the market potential, more than a five-fold increase over a scenario that extends the ITC but allows the CRP to expire as-scheduled. Under the Baseline scenario, total PV capacity installed during the study period will add another 2 MW to PSE's total PV capacity. For comparison, total installed capacity as of the end of 2013 was 10.6 MW, so capacity added during the 20 year study period would likely equal approximately one fifth of the capacity added over the past 5 years. Historically there are low adoption rates among commercial customers in Washington. For a given payback period, residential customers are more likely to install solar than commercial customers. The maximum incentive of $5000/year is a limiting factor for commercial projects. Commercial customers must have quicker paybacks on investments.

Table 9: Summary of Market Potential Results by Scenario in 2020 and 2035

Scenario	2016-2020 Market Potential			2016-2035 Market Potential		
	Residential	Commercial	Total	Residential	Commercial	Total
Baseline	0	0	0	1	2	3
Extended ITC	0	0	1	8	18	26
Extended CRP	16	0	16	147	18	165
Best	33	1	35	297	11	309

ELECTRIC ANALYSIS

Contents

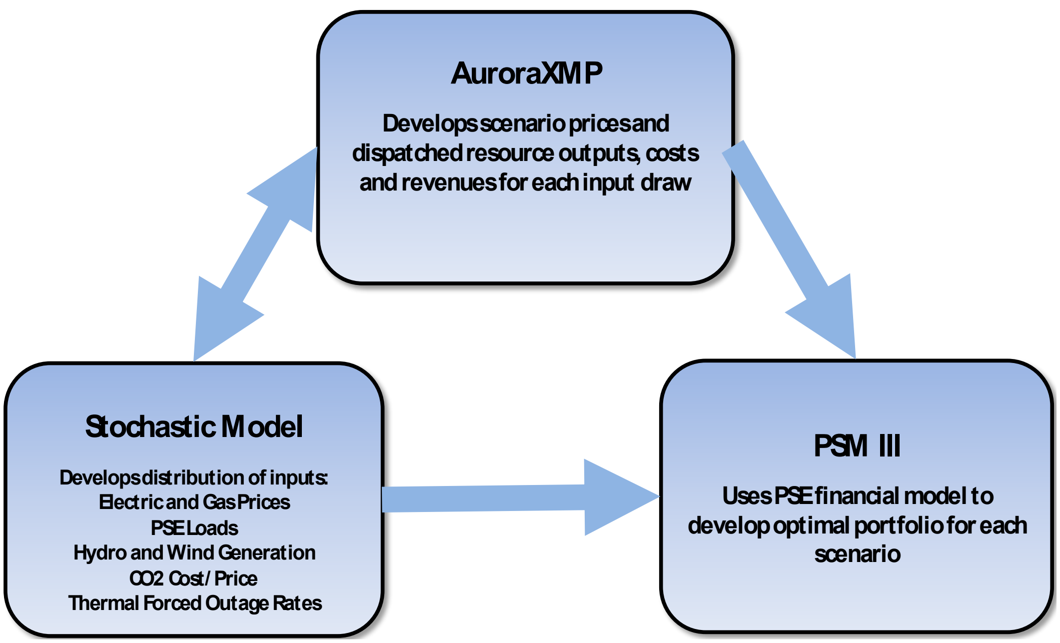
This appendix presents details of the methods and models employed in PSE's electric resource analysis, and the data produced by that analysis.

PORTFOLIO ANALYSIS METHODS

PSE uses three models for electric integrated resource planning: AURORAxmp,® the Portfolio Screening Model III (PSM III), and a stochastic model. AURORA analyzes the western power market to produce hourly electricity price forecasts of potential future market conditions and resource dispatch. PSM III creates optimal portfolios and tests these portfolios to evaluate PSE's long-term revenue requirements for the incremental portfolio and risk of each portfolio. The stochastic model is used to create simulations and distributions for various variables. The following diagram shows the methods used to quantitatively evaluate the lowest reasonable cost portfolio.

Figure N-1 demonstrates how the three models are connected. We first start with the AURORAxmp to develop power prices. Once the power prices are developed, we create a dispatch for PSE's portfolio to use in the PSM III model. PSM III is a linear programming model that is used to find the lowest cost resource plan for each scenario developed in AURORA. Next, we develop stochastic variables around power prices, gas prices, CO_2 prices, hydro generation, wind generation, PSE loads, and thermal plant forced outages.

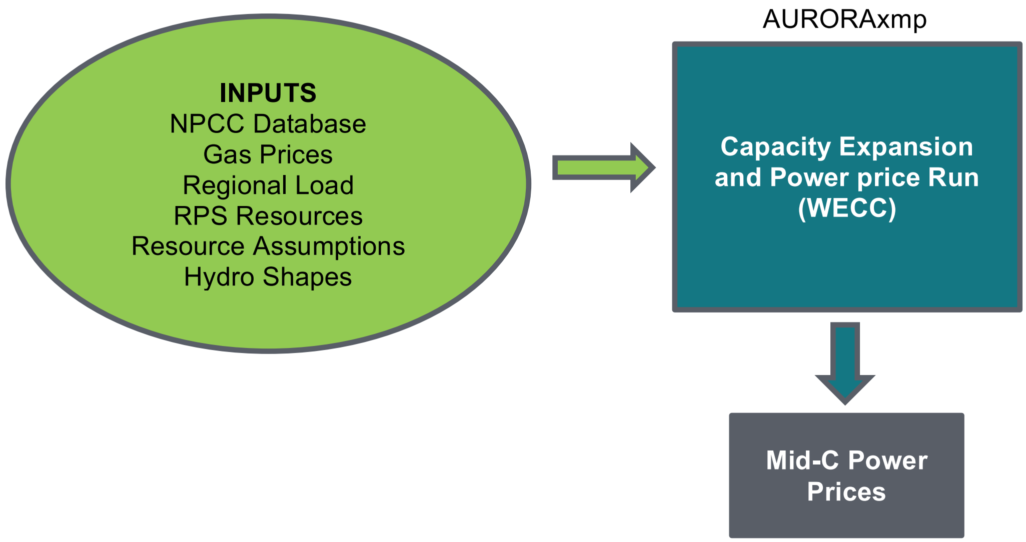
Figure N-1: Electric Analysis Methodology



Developing Wholesale Power Prices

Figure N-2 illustrates PSE's process for creating wholesale market prices in AURORA.

Figure N-2: PSE IRP Modeling Process for AURORA Wholesale Power Prices

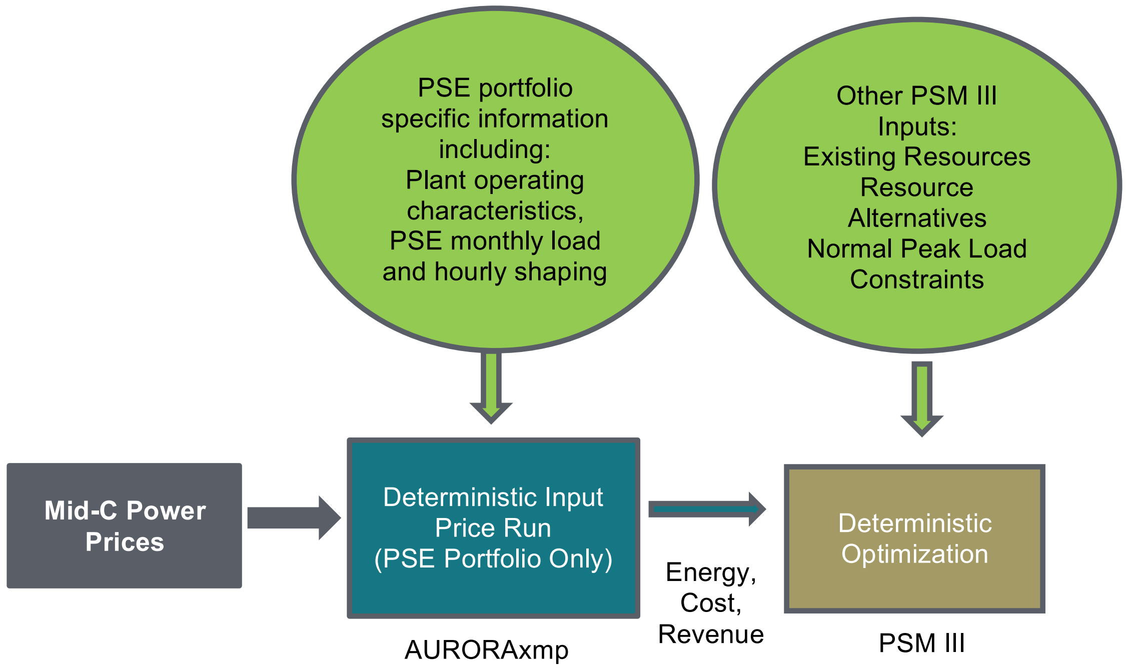


After all of the assumptions are collected and wholesale power prices have been created through AURORA, the next step is portfolio analysis.

Deterministic Portfolio Optimization Analysis

Figure N-3 illustrates PSE's process for creating the lowest cost portfolios through PSM III. Once the power prices are created in AURORA using the WECC-wide database, we use the Mid-C prices as an input to create an input price AURORA analysis. PSE's portfolio is isolated and then dispatched to the Mid-C prices. This Aurora analysis produces estimates of energy (MWh), variable costs including O&M, fuel price and CO_2 price ($000), market revenue ($000), and CO_2 emissions (tons) for all the existing and generic resources. These results are used as inputs for PSM III to create the least-cost portfolio for a scenario using Frontline Systems' Risk Solver Platform optimization model.

Figure N-3: PSE IRP Modeling Process for Portfolio Optimization



Stochastic Risk Analysis

With stochastic risk analysis, we test the robustness of the candidate portfolios. In other words, we want to know how well the portfolio might perform under different conditions. The goal is to understand the risks of different candidate portfolios in terms of costs and revenue requirements. This involves identifying and characterizing the likelihood of bad events and the likely adverse impacts they may have on a given candidate portfolio.

For this purpose, we take the portfolio candidates (drawn from a subset of the lowest cost portfolios produced in the deterministic analysis) and run them through 250 simulations[1] that model varying power prices, gas prices, hydro generation, wind generation, load forecasts (energy and peak), plant forced outages and CO_2 prices. From this analysis, we can observe how risky the portfolio may be and where significant differences occur when risk is analyzed. For example, in the deterministic analysis for this IRP, the frame peaker was lowest cost resource addition in the Base Scenario portfolio, but many other scenarios included the CCCT in the lowest cost portfolio. When we perform the stochastic analysis, we find that the CCCT reduces the portfolio's risk, because it provides a benefit to the portfolio in many of the simulations; by running the stochastic analysis, we learn that balancing the portfolio with both peakers and CCCT plants is the better option. The goal of the process is to find the set of resources with the lowest cost and the lowest risk.

Analysis Tools. A Monte Carlo approach is used to develop the stochastic inputs. Monte Carlo simulations are used to generate a distribution of resource outputs (dispatched to prices and must-take power), costs and revenues from AURORAxmp. These distributions of outputs, costs and revenues are then used to perform risk simulations in the PSM III model where risk metrics for portfolio costs and revenue requirements are computed to evaluate candidate portfolios.

Risk Measures. The results of the risk simulation allow PSE to calculate portfolio risk. Risk is calculated as the average value of the worst 10 percent of outcomes (called TailVar90). This risk measure is the same as the risk measure used by the Northwest Power and Conservation Council (NPCC) in its power plans. Additionally, PSE looked at annual volatility by calculating the standard deviation of the year-to-year percent changes in revenue requirements. A summary measure of volatility is the average of the standard deviations across the simulations, but this can be described by its own distribution as well. It is important to recognize that this does not reflect actual expected rate volatility. The revenue requirement used for portfolio analysis does not include rate base and fixed-cost recovery for existing assets.

1 / Each of the 250 simulations is for the twenty-year IRP forecasting period, 2016 through 2035.

PORTFOLIO ANLAYSIS MODELS

The AURORA Dispatch Model

PSE uses the AURORA model to estimate the regional wholesale market price of power used to serve our core customer load. The model is described below in general terms to explain how it operates, with further discussion of significant inputs and assumptions.

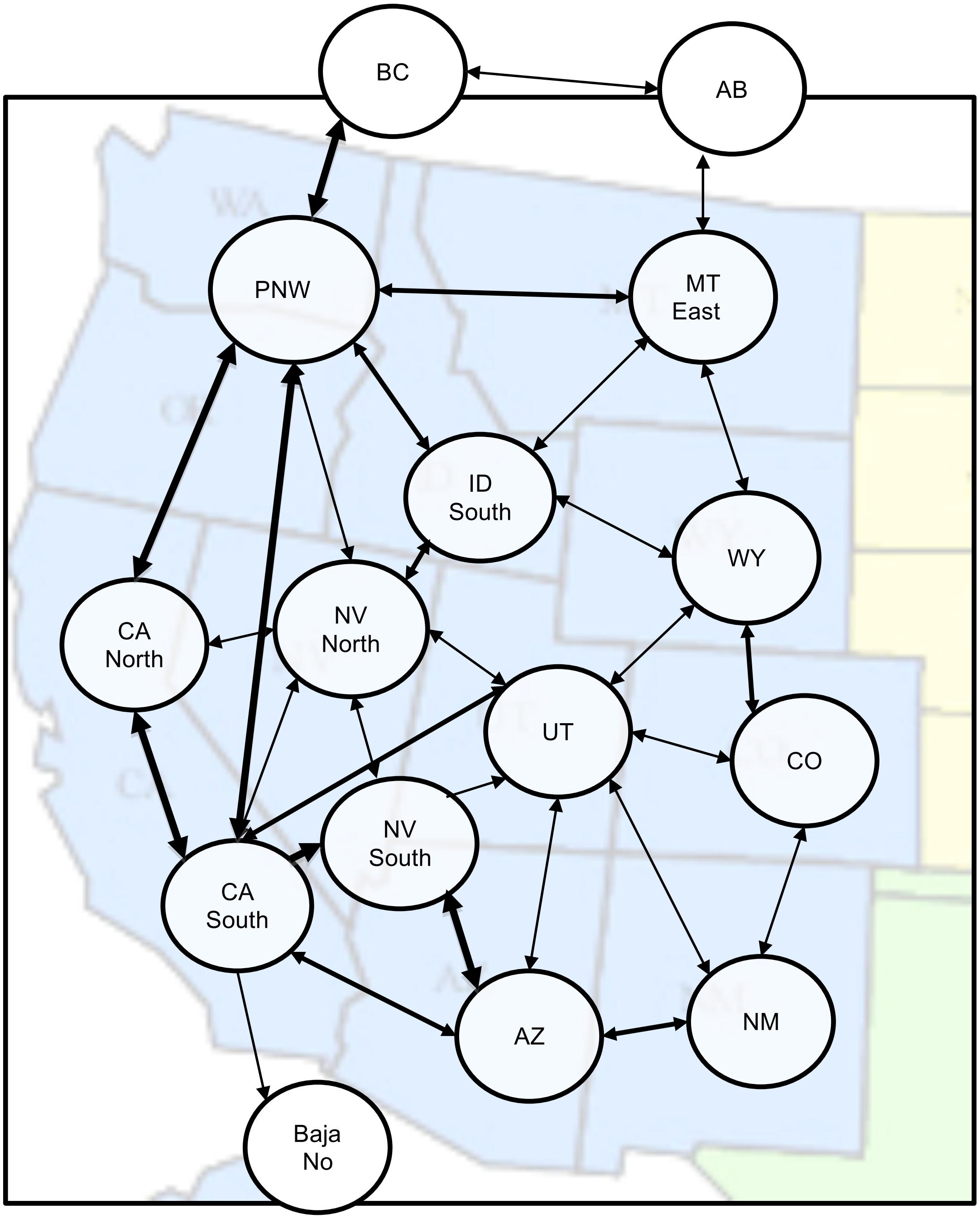
The following text was provided by EPIS, Inc. and edited by PSE.

> AURORA is a fundamentals-based program, meaning that it relies on factors such as the performance characteristics of supply resources and regional demand for power and transmission to drive the electric energy market using the logic of a production costing model. AURORA models the competitive electric market, using the following modeling logic and approach to simulate the markets: Prices are determined from the clearing price of marginal resources. Marginal resources are determined by “dispatching” all of the resources in the system to meet loads in a least-cost manner subject to transmission constraints. This process occurs for each hour that resources are dispatched. Resulting monthly or annual hourly prices are derived from that hourly dispatch.
>
> AURORA uses information to build an economic dispatch of generating resources for the market. Units are dispatched according to variable cost, subject to non-cycling and minimum-run constraints until hourly demand is met in each area. Transmission constraints, losses, wheeling costs, and unit start-up costs are reflected in the dispatch. The market-clearing price is then determined by observing the cost of meeting an incremental increase in demand in each area. All operating units in an area receive the hourly market-clearing price for the power they generate.

AURORA estimates all market-clearing prices for the entire WECC, but the market-clearing price used in PSE’s modeling is the Mid-Columbia hub, or Mid-C price.

Figure N-4 is a depiction of the AURORA system diagram used for the WECC dispatch. The lines and arrows in the diagram indicate transmission links between zones. The heavier lines represent greater capacity to flow power from one zone to another. The Pacific Northwest (PNW) Zone is modeled as the Mid-Columbia (Mid-C) wholesale market price. The Mid-C market includes Washington, Oregon, Northern Idaho and western Montana.

Figure N-4: AURORA System Diagram



Long-run Optimization. AURORA also has the capability to simulate the addition of new generation resources and the economic retirement of existing units through its long-term optimization studies. This optimization process simulates what happens in a competitive marketplace and produces a set of future resources that have the most value in the marketplace. New units are chosen from a set of available supply alternatives with technology and cost characteristics that can be specified through time. New resources are built only when the combination of hourly prices and frequency of operation for a resource generate enough revenue to make construction profitable, unless reserve margin targets are selected. (That is, when investors can recover fixed and variable costs with an acceptable return on investment.) AURORA uses an iterative technique in these long-term planning studies to solve the interdependencies between prices and changes in resource schedules.

Portfolio Screening Model III

The Portfolio Screening Model III (PSM III) is a spreadsheet-based capacity expansion model that the company developed to evaluate incremental costs and risks of a wide variety of resource alternatives and portfolio strategies. This model produces the least-cost mix of resources using a linear programming, dual-simplex method that minimizes the present value of portfolio costs subject to planning margin and renewable portfolio standard constraints.

The solver used for the linear programming optimization is Frontline Systems' Risk Solver Platform. This is an excel add-in that works with the in-house financial model. Incremental costs include: a) the variable fuel cost and emissions for PSE's existing fleet, b) the variable cost of fuel emissions and operations and maintenance for new resources, c) the fixed depreciation and capital cost of investments in new resources, d) the booked cost and offsetting market benefit remaining at the end of the 20-year model horizon (called the "end effects"), and e) the market purchases or sales in hours when resource-dispatched outputs are deficient or surplus to meet PSE's need.

The primary input assumptions to the PSM are:

1. PSE's peak and energy demand forecasts,
2. PSE's existing and generic resources, their capacities and outage rates,
3. expected dispatched energy (MWh), variable cost ($000) and revenue ($000) from AURORAxmp for existing contracts and existing and generic resources,
4. capital and fixed-cost assumptions of generic resources,
5. financial assumptions such as cost of capital, taxes, depreciation and escalation rates,
6. capacity contributions and planning margin constraints, and
7. renewable portfolio targets.

Mathematical Representation of PSM III. The purpose of the optimization model is to create an optimal mix of new generic resources that minimizes the 20-year net present value of the revenue requirement plus end effects (or total costs) given that the portfolio meets the planning margin (PM) and the renewable portfolio standard (RPS), and subject to other various non-negativity constraints for the decision variables. The decision variables are the annual integer number of units to add for each type of generic resource being considered in the model. We may add one or two more constraints later on. The revenue requirement is the incremental portfolio cost for the 20-year forecast.

Let:

gn, gr – index for generic non-renewable and renewable resource at time t, respectively;
xn, xr – index for existing non-renewable and renewable resource at time t, respectively;
d(gn) – index for decision variable for generic non-renewable resource at time t;
d(gr) - index for decision variable for generic renewable resource at time t;

AnnCapCost = annual capital costs at time t for each type of resource (the components are defined more fully in the excel model);
VarCost = annual variable costs at time t for each type of resource (the components are defined more fully in the excel model);
EndEff = end effects at T, end of planning horizon, for each type of generic resource only (the components are defined more fully in the excel model);
ContractCost = annual cost of known power contracts;
DSRCost = annual costs of a given demand side resources;
NetMktCost = Market purchases less market sales of power at time t;
RECSales = Sales of excess over RPS required renewable energy at time t
Cap = capacities of generic and existing resources, and DSR resources;
PM = planning margin to be met each t;
MWH = energy production from any resource type gn,gx,xn,xr at time t;
RPS = percent RPS requirement at time t;
PkLd = expected peak load forecast for PSE at time t;
EnLd = forecasted Energy Load for PSE at generator without conservation at time t;
LnLs = line loss associated with transmission to meet load at meter;
DSR = demand side resource energy savings at time t;
r = discount rate.

Annual revenue requirement (for any time t) is defined as:

$$RR_t = \sum_{gn} d(gn)*[AnnCapCost(gn) + VarCost(gn)] + \sum_{gr} d(gr)*[AnnCapCost(gr) + VarCost(gr)] +$$

$$\sum_{xn} VarCost(xn) + \sum_{xr} VarCost(xr) + ContractCost + DSRCost + NetMktCost - RECSales.$$

The objective function for the model is the present value of RR to be minimized. This function is non-linear with integer decision variables.

$$PVRR = \sum_{t=1}^{T} RR_t *[1/(1+r)^t]+ [1/(1+r)^{20}]*[\sum_{gn} d(gn)*EndEff(gn) + \sum_{gr} d(gr)*EndEff(gr)].$$

The objective function is subject to two constraints

CONSTRAINT #1. The planning margin was found using PSE's Resource Adequacy Model consistent with the 2015 Optimal Planning Standard. Details about the planning margin can be found later in this appendix. In the model, the planning margin is expressed as a percent, and it is used as a lower bound on the constraint. That is, the model must minimize the objective function while maintaining a minimum of this planning margin percent capacity above the load in any given year. Below is the mathematical representation of how the planning margin is used as a constraint for the optimization.

$$\sum_{gn} d(gn)*Cap(gn) + \sum_{gr} d(gr)*Cap(gr) + \sum_{xr} Cap(xr) + \sum_{xn} Cap(xn) \geq PkLd + PM \text{ for all } t;$$

CONSTRAINT #2. PSE is subject to the Washington state renewable target as stated in RCW 19.285. The load input for PSM is the load at generator, so that the company generates enough power to account for line loss and still meet customer needs. The RPS target is set to the average of the previous two years' load at meter less DSR. The model must minimize the objective function while maintaining a minimum of the total RECs needED to meet the state RPS. Below is the mathematical representation of how the RPS is used as a constraint for the optimization.

$$\sum_{gr} d(gr)*MWH(gr) + \sum_{xr} MWH(xr) \geq RPS* \frac{\sum_{t-2}^{t-1}(EnLd*(1-LnLs)-DSR)}{2} \quad \text{for all t;}$$

d(gn), d(gr) ≥ 0, and are integer values for all t,

Other restrictions include total build limits. For example, for the generic wind, 5 plants may be built in a year, for a total of 10 plants over the 20-year time horizon. In the comparison between east and west builds (relative to the Cascade mountain range), the westside natural gas plants were limited to a total of 1,000 MW over the 20 years for both peakers and CCCT.

The model is solved using Frontline Systems' Risk Solver Platform software that provides various linear, quadratic, and nonlinear programming solver engines in Excel environments. Frontline Systems is the developer of the Solver function that comes standard with Excel. The software solves this non-linear objective function typically in less than a minute. It also provides a simulation tool to calculate the expected costs and risk metrics for any given portfolio.

End Effects. The IRP calculation of end effects includes the following: a) a revenue requirement calculation is made for the life of the plant, and b) replacement costs are added for plants that retire during end effects to put all proposals on equal footing in terms of service level.

REVENUE REQUIREMENT. Revenue requirement for end effects is based on the operational characteristics of the 20th year in the dispatch model and an estimate of dispatch, based on the last 5 years of AURORA dispatch. The revenue requirement calculation takes into account the return on ratebase, operating expenses, book depreciation and market value of the output from the plant. The operating expenses and market revenues are escalated at a standard escalation rate using an average of the last 5 years of AURORA dispatch as the starting point.

REPLACEMENT COSTS ON AN EQUIVALENT LIFE BASIS. To account for the differences in lives of projects the model includes a replacement resource at the end of the project life in the end effects period. Capacity resources are replaced with an equivalent type and amount of generic capacity resource, while renewable resources are replaced by an equivalent generic wind plant on a REC basis. The fixed capital cost of the replacement resource is added based on the estimated generic resource cost in the year of replacement on a level annual basis – equal annual costs until the end of the end-effects period. The variable cost, market revenue, and fixed operations cost are included based on an estimate of the costs using the standard inflation factor and the dispatch from the last 5 years of AURORA dispatch. By adding replacements in end effects on a levelized cost basis, the model is creating equivalent lives for all the resources. The end-effects period extends 34 years beyond the initial 20-year planning horizon.

Monte Carlo Simulations for the Risk Trials. PSE utilized the 250 simulations from the stochastic model as the basis for the 1,000 risk trials. For each of the 1,000 trials, a simulation was chosen at random from the 250 simulations and the revenue requirement for the portfolio was calculated using all the outputs associated with that simulation (Mid-C power price, CO_2 cost/price, Sumas natural gas prices, hydro generation, wind generation and PSE load).

Stochastic Portfolio Model

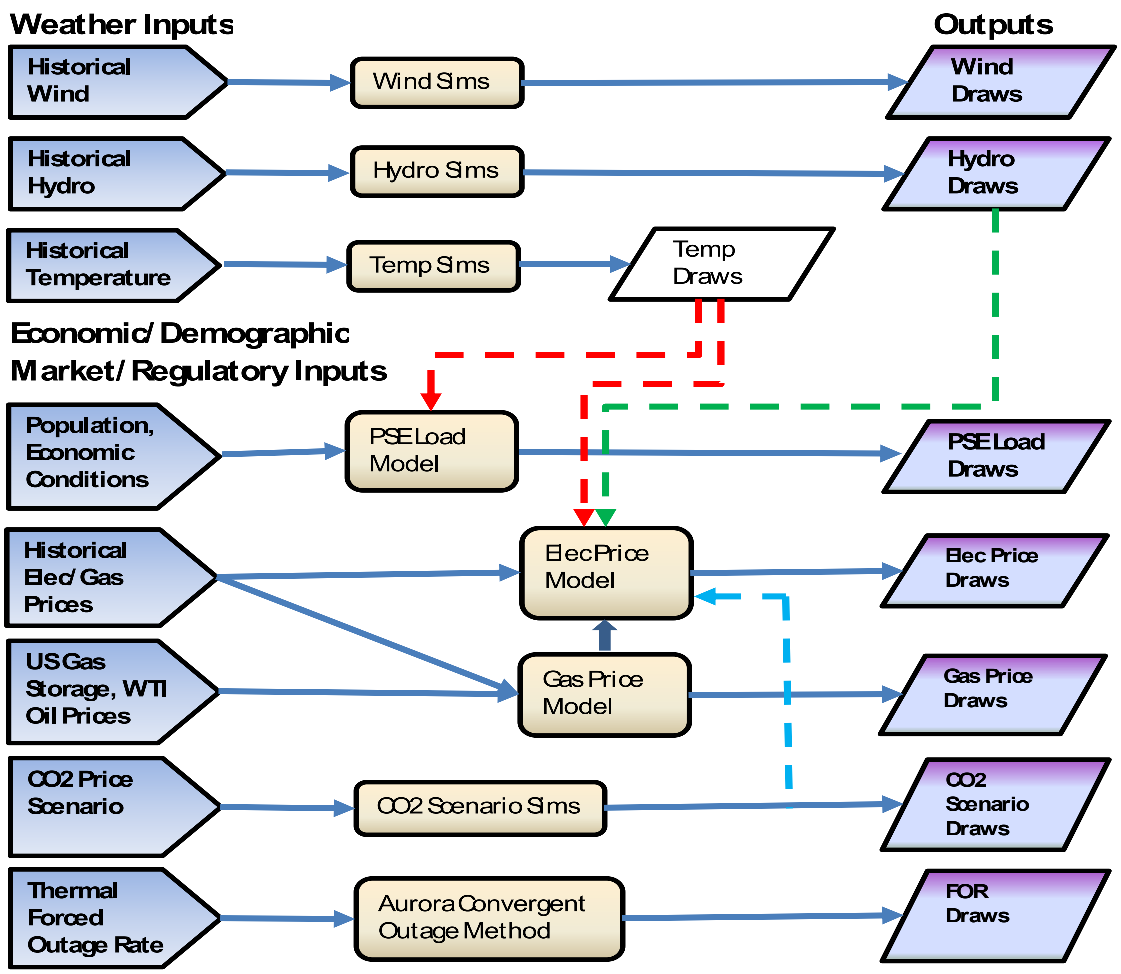
The goal of the stochastic modeling process is to understand the risks of alternative portfolios in terms of costs and revenue requirements. This process involves identifying and characterizing the likelihood of bad events and the likely adverse impacts of their occurrence for any given portfolio. The modeling process used to develop the stochastic inputs is a Monte Carlo approach. Monte Carlo simulations are used to generate a distribution of resource energy output (dispatched to prices and must-take), costs and revenues from AURORAxmp. These distributions of outputs, costs and revenues are then used to perform risk simulations in the PSM III model where risk metrics for portfolio costs and revenue requirements are computed to evaluate alternative portfolios. The stochastic inputs considered in this IRP are Mid-C power price, gas prices for Sumas hub, PSE loads, hydropower generation, wind generation, risk of CO_2 prices and thermal plant forced outages. This section describes how PSE developed these stochastic inputs.

Development of Monte Carlo Simulations for the Stochastic Variables. A key goal in the stochastic model is to be able to capture the relationships of major drivers of risks with the stochastic variables in a systematic way. One of these relationships, for example, is that variations in Mid-C power prices should be correlated with variations in Sumas gas prices, contemporaneously or with a lag. Another important aspect in the development of the stochastic variables is the imposition of consistency across simulations and key scenarios. This required ensuring, for example, that the same temperature conditions prevail for a load simulation and for a power price simulation. Figure N-5 shows the key drivers in developing these stochastic inputs. In essence, weather variables, long-term economic conditions and energy markets, and regulation determine the variability in the stochastic variables. Furthermore, two distinct approaches were used to develop the 250 Monte Carlo simulations for the inputs: a) loads and prices were developed using econometric analysis given their connection to weather variables (temperature and water conditions), key economic assumptions and the risks of CO_2 price policy, and b) temperature, hydro and wind variability were based directly on historical information assumed to be uniformly distributed, while the risks of a CO_2 prices were based on probability weights.

The econometric equations estimated using regression analysis provide the best fit between the individual explanatory values and maximize the predictive value of each explanatory variable to the dependent variable. However, there exist several components of uncertainty in each equation, including: a) uncertainty in the coefficient estimate, b) uncertainty in the residual error term, c) the covariate relationship between the uncertainty in the coefficients and the residual error, and d) uncertainty in the relationship between equations that are simultaneously estimated. Monte Carlo simulations utilizing these econometric equations capture these elements of uncertainty.

By preserving the covariate relationships between the coefficients and the residual error, we are able to maintain the relationship of the original data structure as we propagate results through time. For a system of equations, correlation effects between equations are captured through the residual error term. The logic of the linked physical and market relationships needs to be supported with solid benchmark results demonstrating the statistical match of the input values to the simulated data.

Figure N-5: Stochastic Model Diagram



PSE LOAD FORECAST. PSE developed a set of 250 Monte Carlo load forecast simulations by allowing two sets of variable inputs to vary for each simulation: weather and economic-demographic conditions. The 250 unique annual temperature profiles were created synthetically. For each temperature profile, an annual hourly temperature shape was selected randomly from the 76 years worth of hourly shapes. Temperature simulations used were from two sets of data: a) 1929-1947 data from Portage Bay (near UW), and b) 1948-2005 data from SeaTac Airport. The heating degree days (HDDs) and cooling degree days (CDDs) were based on each temperature year simulation run through the demand forecast model to get the impacts on month/hourly profiles and use-per-customer. By this process, PSE is able to create an infinite amount of unique temperature profiles to test possible load outcomes. For the current IRP, 250 annual temperature profiles were generated. Monte Carlo simulations on economic and demographic inputs are based on historical standard errors of growth in macroeconomic and key regional inputs into the model such as population, employment and income. The stochastic simulation also accounts for the error distribution of the estimated customer counts and use-per-customer equations and the estimated equation parameters.

Why does PSE use different historical periods for different load analysis?

The Resource Adequacy Model (RAM) and the load forecasts in the scenario and stochastic portfolio analyses are done using different historical periods because these analyses are used for different types of planning.

The stochastic analysis performed by the RAM uses 80 years of historic weather and hydro conditions in addition to risks in market reliance, variability of wind generation, and random forced outages in thermal plants. Because the risks in market reliance need to be consistent with the regional outlook where the 80 years of hydro conditions and 77 years of weather years were imposed, PSE's Resource Adequacy Model was revised to account for these conditions in a consistent way.

The goal of the stochastic portfolio analysis is to examine the resource plans over a wide range of potential futures, knowing the region will not experience normal weather (load) and hydro conditions each year during the planning horizon, including variations in gas and electric prices, wind generation and thermal forced outages. In fact, most years may be abnormal in at least one of the aspects listed above. Understanding the strengths and weakness of each candidate portfolio over a wide variety of potential futures is essential for a thorough analysis of each candidate portfolio. This stochastic portfolio model uses 83 weather years starting from 1929. While no correlations were imposed on weather and hydro conditions, each of these factors were correlated with prices and loads.

The load forecast used in the deterministic portfolio scenario analysis is based on "normal" weather, where normal weather is defined as the average of the most recent last 30 years of weather data. The goal of this analysis is to use "normal" weather to forecast future loads, assuming the region experiences average weather each year. Loads forecast with "normal" weather were used in the base case scenarios of the portfolio analysis. PSE had hoped to explore different definitions of normal for the load forecast in this IRP, such as using the last 15 years instead of 30 years, but did not have time. The primary impact would be to change expected "normal" load, which may or may not have an impact on peak capacity need, but could impact renewable resource need, because it is a function of MWh energy sales.

Figures N-6 and N-7 depict a graphical representation of the load forecast simulations for energy and peak.

Figure N-6: Load Forecast Simulations – Annual Energy (aMW)

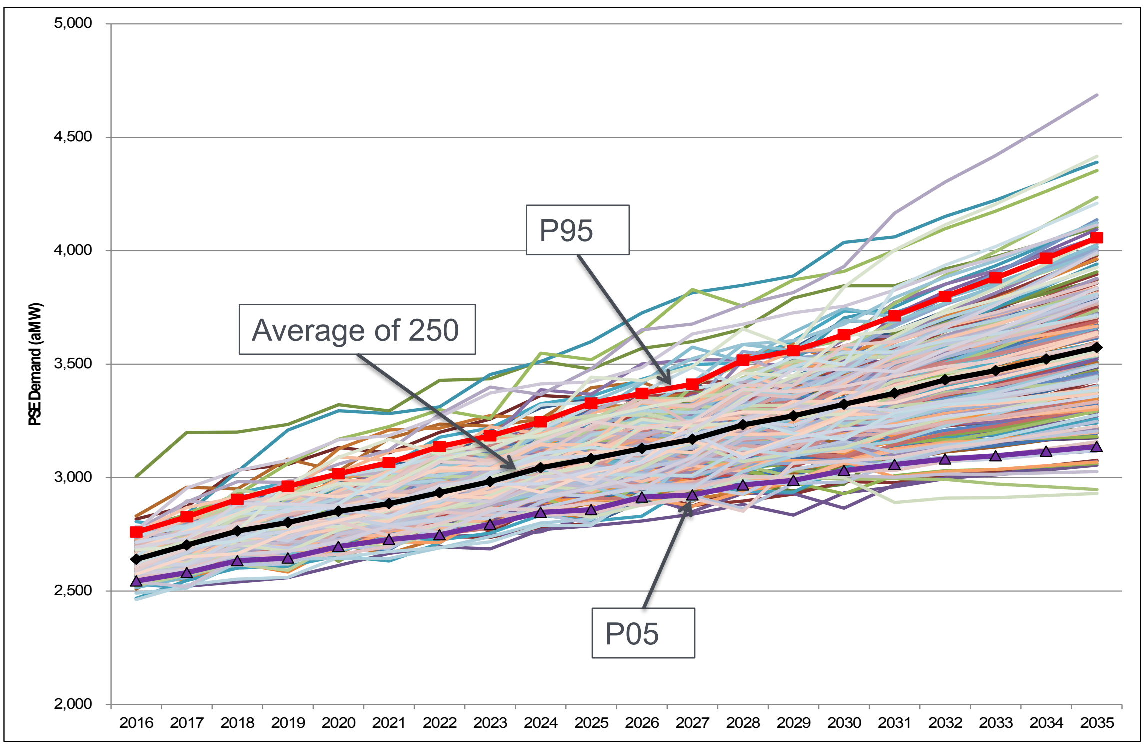
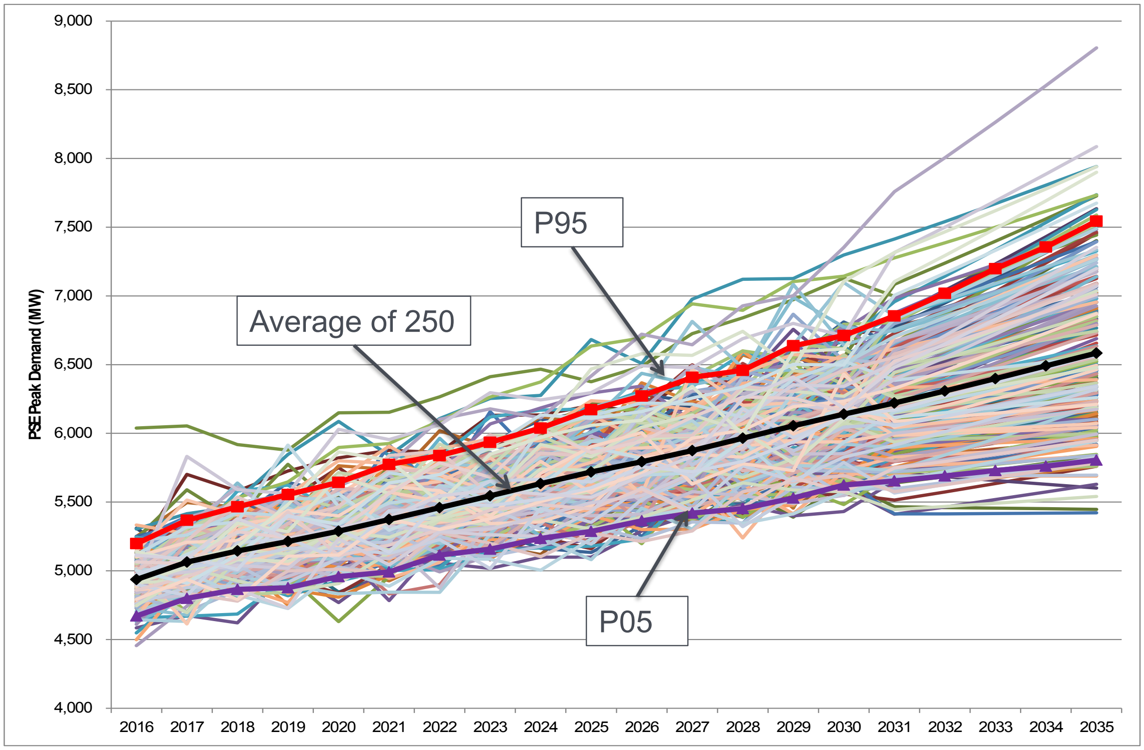


Figure N-7: Load Forecast Simulations – December 1-hour Peak (MW)



GAS AND POWER PRICES. The econometric relationship between prices and their explanatory variables is shown in the equations below:

Sumas Gas Price = f(US Gas Storage Deviation fr. 5 Yr Avg, Oil Price, Lagged Oil Price, Time Trend,Fracking Effects)

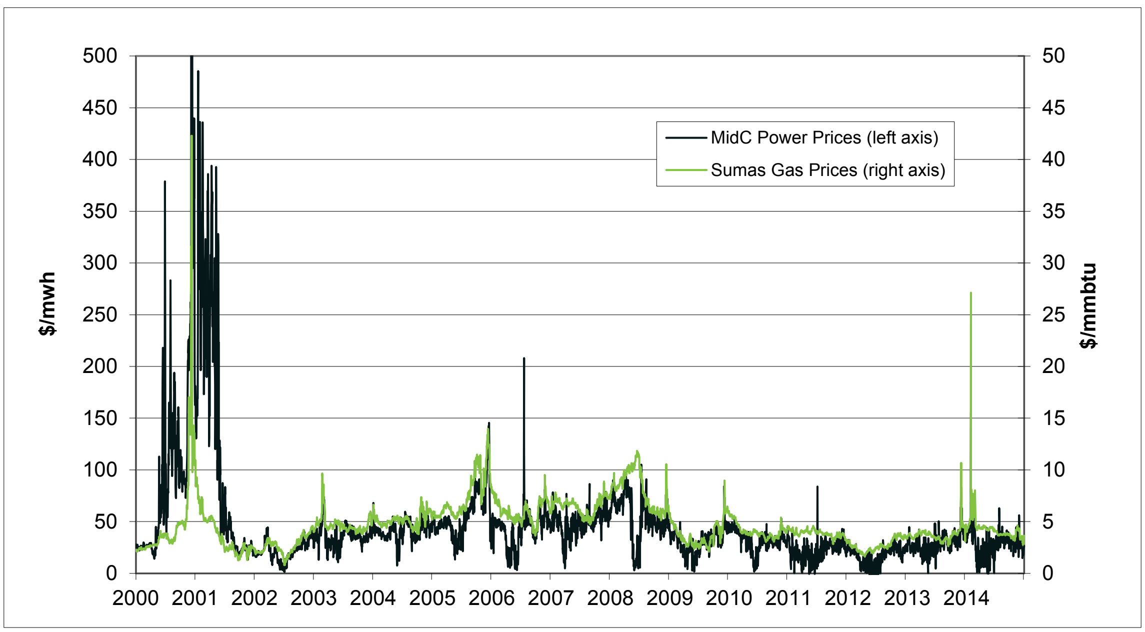
Mid-C Power Price = f(Sumas Gas Price, Regional Temperature Deviation from Normal, Mid-C Hydro Generation, Day of Week, Holidays)

A semi-log functional form is used for each equation. These equations are estimated simultaneously with one period autocorrelation using historical daily data from January 2003 to December 2014. The Fracking Effects in the Sumas gas price equation accounted for the impacts of fracking technology on the historical gas price series starting in 2010.

Monte Carlo simulations were obtained based on the error distributions of the estimated equations, oil price simulations, temperature simulations and hydro condition simulations. The temperature simulations are consistent with those drawn for the load forecast, while the hydro simulations are consistent with those drawn directly from the 70-year historical hydro data as described below. Gas price simulations were further adjusted so that the 10th percentile and 90th percentiles correspond to the low and high gas price scenarios, respectively, based on the rank levelized price of each simulation. The price simulations were calibrated to ensure that the means of adjusted distributions are equal to the base case prices. Hourly power prices were then obtained using the hourly shape for the base case from AURORAxmp. Mid-C power price simulations in the presence of risks of CO_2 cost/price policies were adjusted based on the observed changes in power price forecasts from AURORAxmp model runs when CO_2 costs/prices were imposed at different levels. Mid-C power prices are generally higher when CO_2 costs/prices are included.

Figure N-8 shows the historical trends in daily Mid-C power price and Sumas gas price from 2000 to 2010 including the price spikes in late 2000 to early 2001 due to the California crisis.

Figure N-8: Historical Mid-C Power Price and Sumas Gas Price



The annual Sumas gas price simulations are shown in Figure N-9. The Annual Mid-C power price simulations are shown in figure N-10.

Figure N-9: Annual Sumas Gas Price Simulations

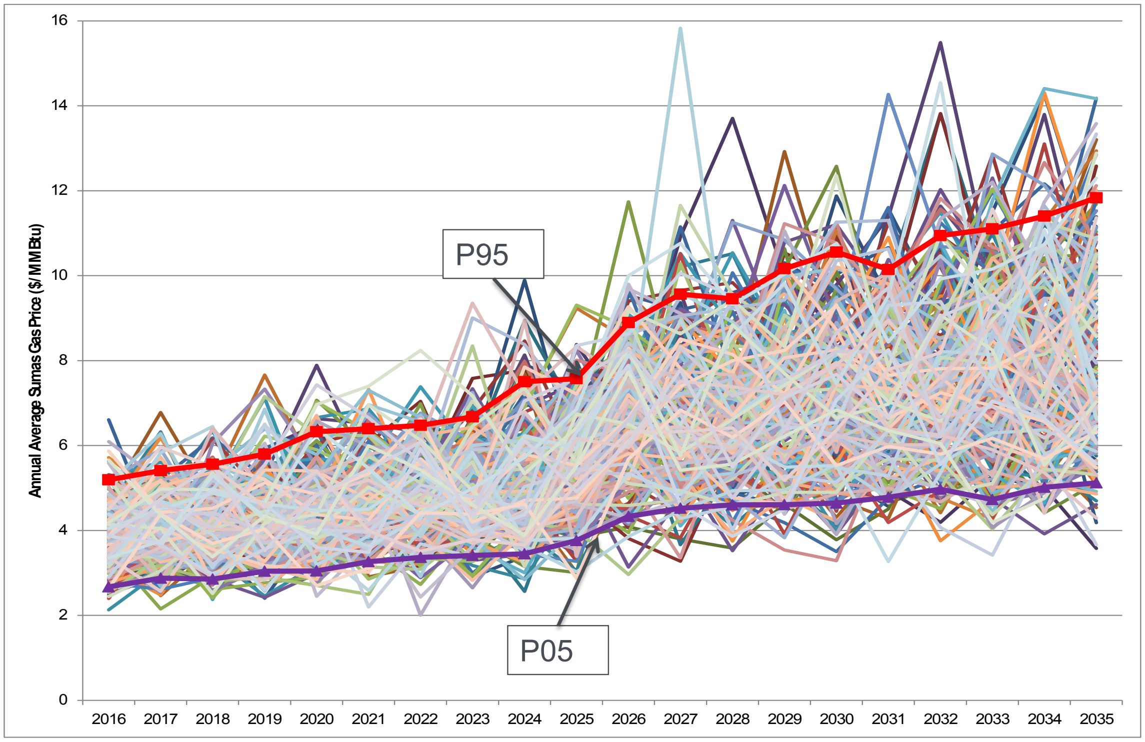
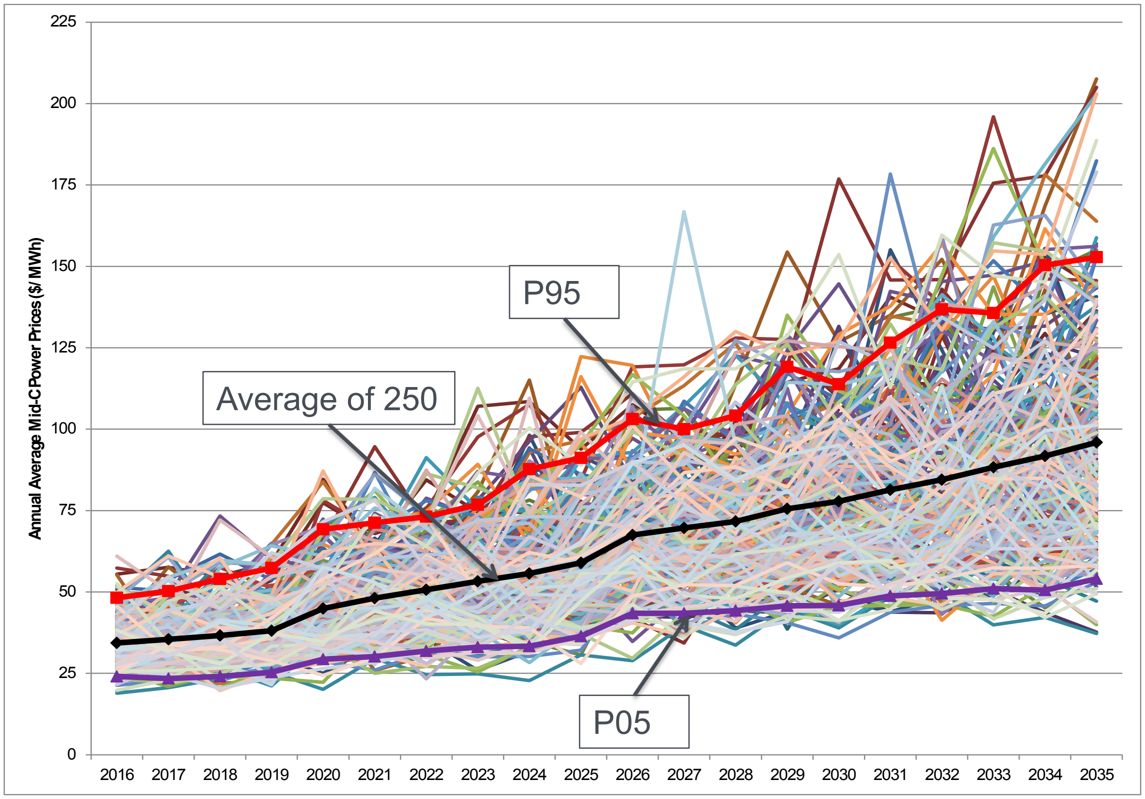
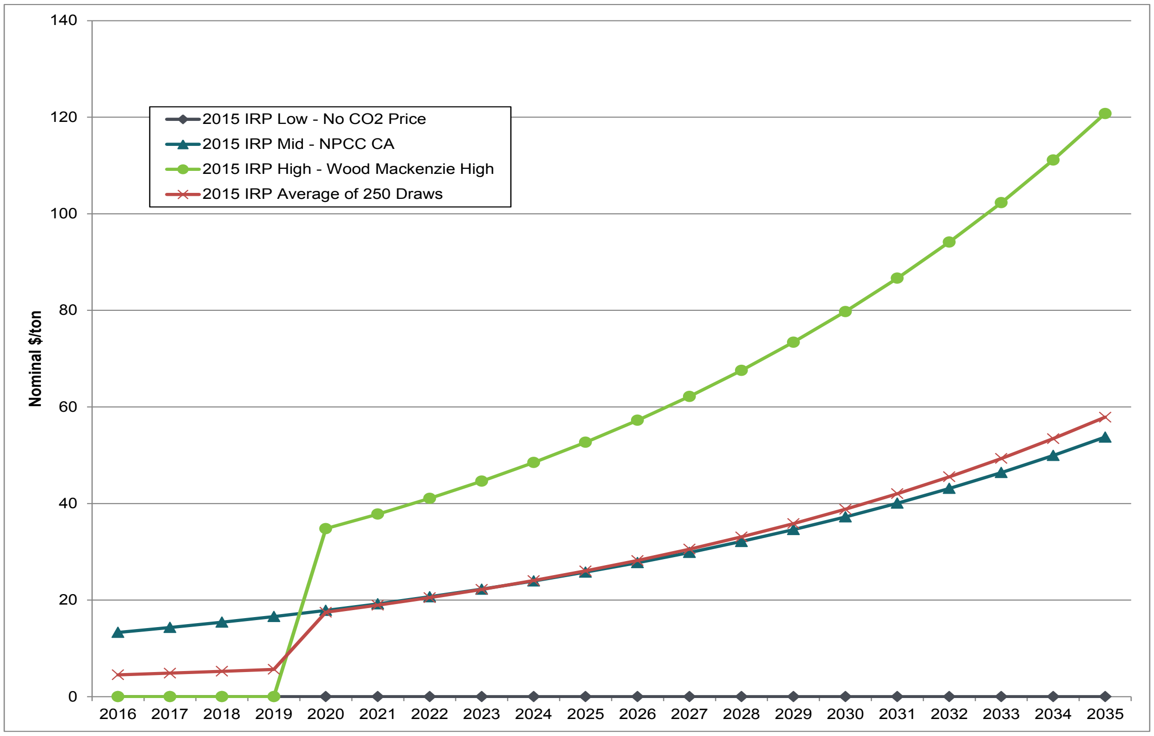


Figure N-10: Annual Mid-C Price Simulations



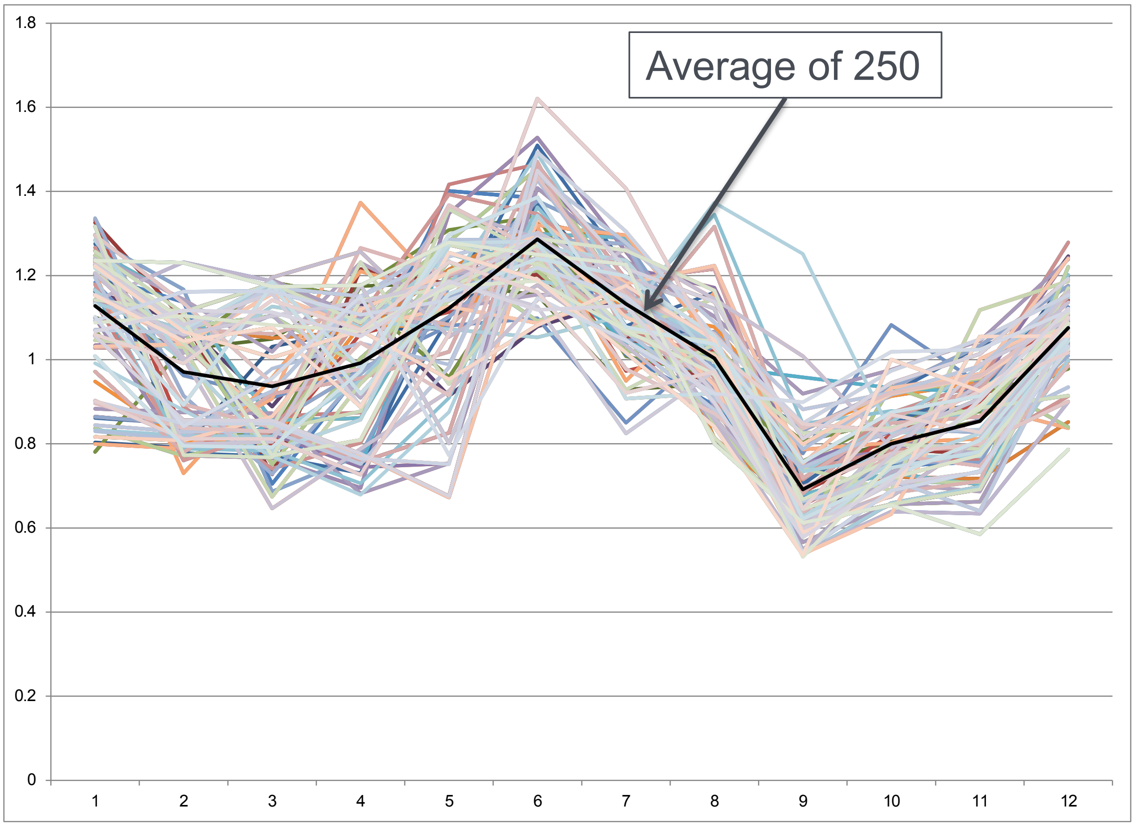
RISKS OF CO_2 PRICE. Because of the changes in legislative agenda in the last 2-3 years, there was greater uncertainty about whether a CO_2 policy would be implemented in the future. As a result, the risk of a CO_2 policy was modeled differently in this IRP. Given the possible range of CO_2 price per ton assumed in the deterministic scenarios as described in Chapter 4 and later in this appendix, subjective probabilities were assigned to each of these price scenarios representing their likelihood of being implemented. The three scenarios and their respective probabilities are No CO_2 – 33.3 percent, Mid CO_2 – 33.3 percent, and High CO_2 – 33.3 percent. The assigned probabilities still imply that there is greater than 50 percent chance of a positive CO_2 cost/price being imposed in the future for this risk study. Figure N-11 shows the annual CO_2 cost/price simulations with the weighted average of all simulations.

Figure N-11: Annual Mid-C Price Simulations with Weighted CO_2 Inputs



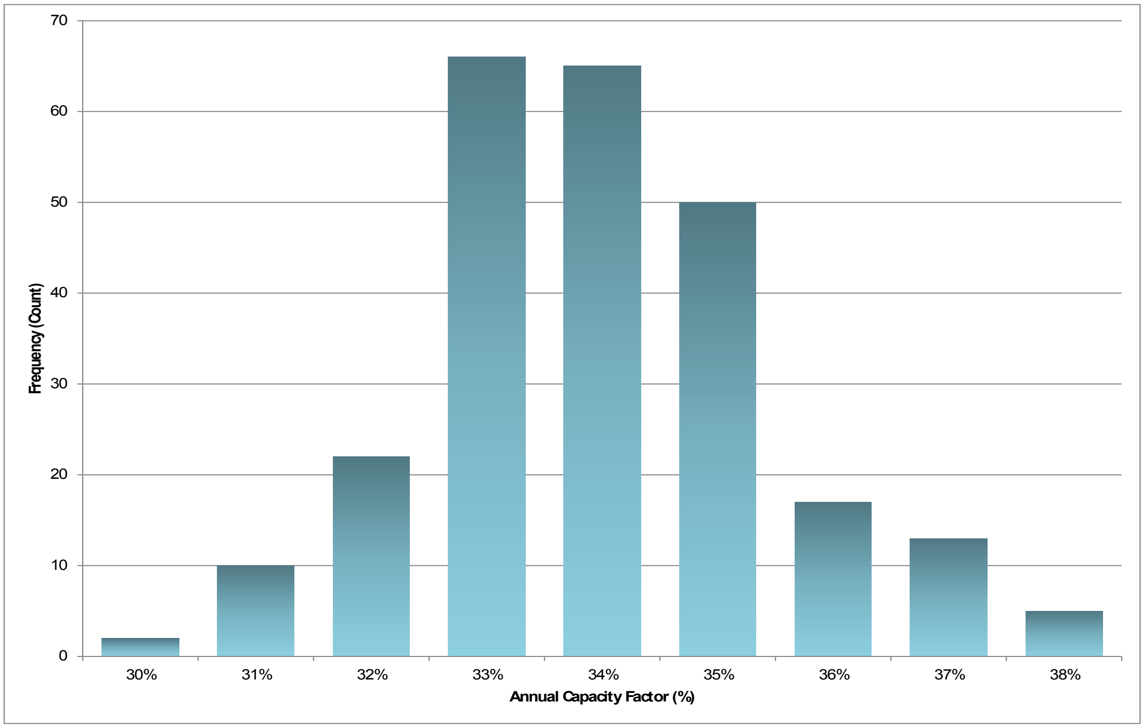
HYDRO GENERATION. Monte Carlo simulations for each of PSE's hydro projects were obtained using the 80-year historical Pacific Northwest Coordination Agreement Hydro Regulation data (1929-2008). Each hydro year is assumed to have an equal probability of being drawn in any given calendar year in the planning horizon. Capacity factors and monthly allocations are drawn as a set for each of the 250 simulations. A different set of 250 hydro simulations is applied for each year in the planning horizon. Figure N-12 shows the monthly flows/capacity factors for all five PSE contracted Mid-C projects. See Appendix D for discussion of which projects PSE has contracted.

Figure N-12: Monthly Capacity Factor for 5 Mid-C Hydro Projects



WIND GENERATION. Since wind is an intermittent resource, one of the goals in developing the generation profile for each wind project considered in this IRP is to ensure that this intermittency is preserved. The other goals are to ensure that correlations across wind farms and the seasonality of wind generation are reflected. The wind distributions were derived from 9 years of historical data from Hopkins Ridge and Wild Horse. Given the limited historical data that is available to generate the 250 hourly wind profiles, simulations of daily 24-hour wind profiles are made each month with each day having an equal probability of being chosen until all days in the month are populated. Since simulations for each month are based only on daily profiles within each month, the seasonality of wind generation is also preserved. Finally, simulations across wind farms are synchronized on a daily basis to preserve any correlations that may exist between Hopkins Ridge and Wild Horse. The Lower Snake River wind farm only has 2 years of operating data, so the data was filled out with the same wind profile as Hopkins Ridge, with a lag since it is located near Hopkins Ridge, and scaled to its nameplate capacity and pro-forma capacity factor. Finally, the generic wind farm is assumed to have a wind profile distribution similar to that of Hopkins Ridge and Lower Snake River, scaled to a 100 MW capacity. Again, a different set of 250 simulations is used for each of the calendar years in the planning horizon to ensure that there is also weather variation across years. Figure N-13 illustrates the frequency of the annual capacity factor for the generic wind project across all 250 simulations.

Figure N-13: Generic Washington Wind Simulations,
Frequency of Annual Capacity Factor for 250 Simulations



THERMAL PLANT FORCED OUTAGES. A new addition to the stochastic modeling for the 2015 IRP is simulation of the unplanned outages (forced outages) for the thermal plants for both existing and generic plants. This was modeled using the "Frequency Duration" outage method in AURORAxmp. The frequency duration outage method allows units to fail or return to service at any time-step within the simulation, not just at the beginning of a month or a day. The frequency and duration method assumes units are either fully available or completely out of service. The inputs needed are forced outage rate (FOR) and mean time to repair (MTTR) which is used to compute the mean time to fail. This data is based on the 5-year historical operations of the existing thermal plants. This method is for risk studies and does not guarantee to meet the FOR in one year, but the 250 simulations will average to the FOR. This results in different random outages each year.

AURORA Risk Modeling of PSE Portfolios. The economic dispatch and unit commitment capabilities of AURORAxmp are utilized to generate the variable costs, outputs and revenues of any given portfolio and input simulations. The main advantage of using AURORAxmp is its fast hourly dispatch algorithm for 20 years, a feature that is well known by the majority of Northwest utilities. It also calculates market sales and purchases automatically, and produces other reports such as fuel usage and generation by plant for any time slice. Instead of defining the distributions of the risk variables within AURORAxmp, however, the set of 250 simulations for all of the risk variables (power prices, gas prices, CO_2 costs/prices, PSE loads, hydro generation, and wind generation) are fed into the AURORAxmp model. The thermal plant forced outage is simulated in AURORA at the same time as it is running the dispatch for the simulation. Given each of these input simulations, AURORAxmp then dispatches PSE's existing portfolio and all generic resources to market price. The results are then saved and passed on to the PSM III model where the dispatch energy, costs and revenues for each simulation are utilized to obtain the distribution of revenue requirements for each set of generic portfolio builds.

Risk Simulation in PSM III. In order to perform risk simulation of any given portfolio in PSM III, the distribution of the stochastic variables must be incorporated into the model. The base case 250 simulations of dispatched outputs, costs and revenues for PSE's existing and generic resources were fed into PSM III from AURORAxmp and the stochastic model as described above. Note that these AURORAxmp outputs have already incorporated the variability in gas and power prices, CO_2 price, PSE's loads, hydro and wind generation from the stochastic model. Frontline Systems' Risk Solver Platform Excel Add-On allows for the automatic creation of distributions of energy outputs, costs and revenues based on the 250 simulations that PSM III can utilize for the simulation analysis. In addition, peak load distribution, consistent with the energy load distribution, was incorporated into the PSM III. Given these distributions, the risk simulation function in the Risk Solver Platform allowed for drawing 1,000 trials to obtain the expected present value of revenue requirements, TailVar90, and the volatility index for any given portfolio. In addition to computing the risk metrics for the present value of revenue requirements, risk metrics are also computed for annual revenue requirements and market purchased power costs. The results of the risk simulation are presented in Chapter 6 and in the "Outputs" section of this appendix.

KEY INPUTS AND ASSUMPTIONS

AURORA Inputs

Numerous assumptions are made to establish the parameters that define the optimization process. The first parameter is the geographic size of the market. In reality, the continental United States is divided into three regions, and electricity is not traded between these regions. The western-most region, called the Western Electricity Coordinating Council (WECC), includes the states of Washington, Oregon, California, Nevada, Arizona, Utah, Idaho, Wyoming, Colorado, and most of New Mexico and Montana. The WECC also includes British Columbia and Alberta, Canada, and the northern part of Baja California, Mexico. Electric energy is traded and transported to and from these foreign areas, but is not traded with Texas, for example.

For modeling purposes, the WECC is divided into 16 areas, primarily by state and province, except for California which has three areas, Nevada which has two areas, and Oregon, Washington, Idaho and Montana, which combined have three areas. These areas approximate the actual economic areas in terms of market activity and transmission. The databases are organized by these areas and the economics of each area is determined uniquely.

All generating resources are included in the resource database, along with characteristics of each resource, such as its area, capacity, fuel type, efficiency and expected outages (both forced and unforced). The resource database assumptions are based on EPIS's 2012.01 version produced in January 2012 with updates to include coal plant retirements, new WECC builds not included in the database and the California Once-Through-Cooling (OTC) plant retirements. See following sections for more details.

Many states in the WECC have passed statutes requiring Renewable Portfolio Standards (RPS) to support the development of renewable resources. Typically, an RPS state has a specific percentage of energy consumed that must come from renewable resources by a certain date (e.g., 10 percent by 2015). While these states have demonstrated clear intent for policy to support renewable energy development, they also provide pathways to avoid such strict requirements. Further details of these assumptions are discussed in the Section titled "Renewable Portfolio Standard (WECC)," below.

Water availability greatly influences the price of electric power in the Northwest. PSE assumes that hydropower generation is based on the average stream flows for the 80 historical years of 1929 to 2008. While there is also much hydropower produced in California and the Southwest (e.g., Hoover Dam), it does not drive the prices in those areas as it does in the Northwest. In those areas, the normal expected rainfall, and hence the average power production, is assumed for the model. For sensitivity analysis, PSE can vary the hydropower availability using the 80-year historical stream flows.

Electric power is transported between areas on high voltage transmission lines. When the price in one area is higher than it is in another, electricity will flow from the low priced market to the high priced market (up to the maximum capacity of the transmission system), which will move the prices closer together. The model takes into account two important factors that contribute to the price: First, there is a cost to transport energy from one area to another, which limits how much energy is moved; and second, there are physical constraints on how much energy can be shipped between areas. The limited availability of high voltage transportation between areas allows prices to differ greatly between adjacent areas. EPIS updates the model to include known upgrades (e.g., Path 15 in California) but the model does not add new transmission "as needed."

Regional Load Forecast. Load forecasts are created for each area. These forecasts include the base-year load forecast and an annual average growth rate. Since the demand for electricity changes over the year and during the day, monthly load shape factors and hourly load shape factors are included as well. All of these inputs vary by area: For example, the monthly load shape would show that California has a summer peak demand and the Northwest has a winter peak. For the 2015 IRP, load forecasts for Oregon, Washington, Montana and Idaho were based on the Northwest Power and Conservation Council (NPCC) 2013 regional forecast mid-term update load forecast, net of conservation.

Natural Gas Prices. For gas price assumptions, PSE uses a combination of forward market prices, fundamental forecasts acquired in November 2014 from Wood Mackenzie, and forecasts developed by the NPCC. Wood MacKenzie is a well-known macroeconomic and energy forecasting consultancy whose gas market analysis includes regional, North American and international factors, as well as Canadian markets and liquefied natural gas (LNG) exports. The NPCC focuses on energy planning issues in the Northwest region. Four gas price forecasts are used in the scenario analysis:

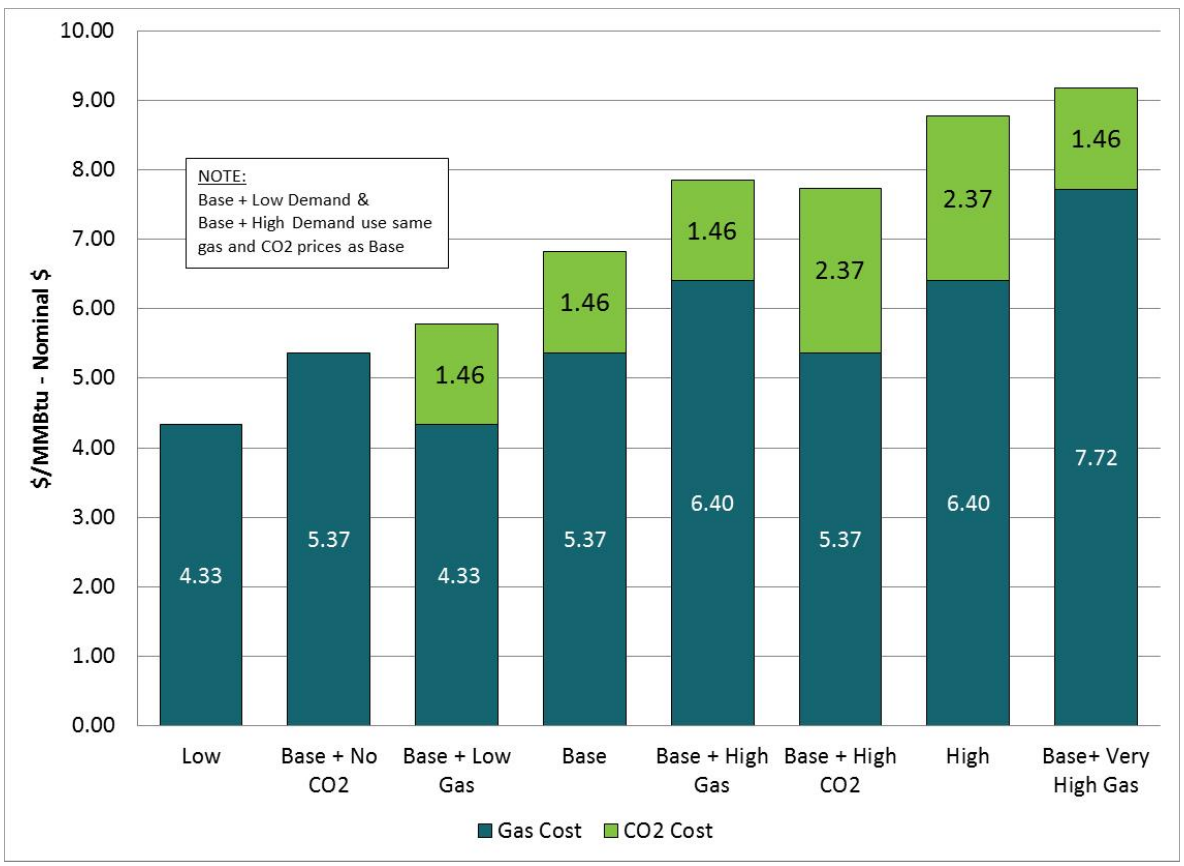
LOW GAS PRICES. These reflect Wood Mackenzie's long-term low price forecast for 2016-2035.

MID GAS PRICES. From 2016-2019, this IRP uses the three-month average of forward marks for the period ending November 14, 2014. Forward marks reflect the price of gas being purchased at a given point in time for future delivery. Beyond 2019, this IRP uses Wood Mackenzie long-run, fundamentals-based gas price forecasts. The Base Scenario uses this forecast.

HIGH GAS PRICES. These reflect Wood Mackenzie's long-term high price forecast for 2016-2035.

VERY HIGH GAS PRICES. This forecast reflects the NPCC high gas price forecast developed in July 2014.

Figure N-14: Levelized Gas Prices by Scenario
(Sumas Hub, 20-year levelized 2016-2035, nominal $)



CO_2 Price. To model uncertainty around CO_2 prices, PSE developed the following estimates as inputs. These estimates reflect the potential for CO_2 price regulation and how that might affect resource decisions, rather than incorporating the societal cost of carbon emissions as an externality. The annual CO_2 prices modeled are presented in Figure N-15.

NO FEDERAL CO_2 PRICE. $0 PER TON. The lowest CO_2 price used in the 2015 IRP assumes no federal CO_2 price, but does include an NPCC forecast of California CO_2 prices based on the California Global Warming Solutions Act of 2006 (AB32).[2] This CO_2 price is applied to power plants located in California.

MID CO_2 PRICE. $13 PER TON IN 2016 TO $54 PER TON IN 2035. This estimate is based on NPCC's estimated CO_2 price for California AB32 and is applied as a federal CO_2 price to all resources.

HIGH CO_2 PRICE. $35 PER TON IN 2020 TO $120 PER TON IN 2035. This estimate of federal CO_2 price comes from the Wood Mackenzie high gas price forecast; California CO_2 price are increased to match federal CO_2 price.

2 / *See Appendix C, Environmental Matters, for more details on the California Global Warming Solutions Act.*

Figure N-15: Annual CO_2 Costs (Nominal $/Ton)

	Low	Base	High
2016	-	13.31	-
2017	-	14.32	-
2018	-	15.41	-
2019	-	16.59	-
2020	-	17.85	34.79
2021	-	19.22	37.80
2022	-	20.68	41.07
2023	-	22.26	44.62
2024	-	23.96	48.48
2025	-	25.78	52.68
2026	-	27.75	57.23
2027	-	29.86	62.18
2028	-	32.14	67.56
2029	-	34.59	73.41
2030	-	37.23	79.76
2031	-	40.07	86.65
2032	-	43.12	94.15
2033	-	46.41	102.29
2034	-	49.95	111.14
2035	-	53.76	120.76

Emission Standards/Coal-fired Power Plant Retirements. PSE added constraints on coal technologies to the AURORA model in order to reflect current political and regulatory trends. Specifically, no new coal builds were allowed in any state in the WECC. The Northwest Power and Conservation Council Sixth Power Plan database was used in this IRP, which includes planned coal power plant retirement. We also added 1,860 MW coal retirement based on coal retirement report from SNL Energy as of Oct. 2014. In addition, the High, Base + Low Gas Price, and Base + High CO_2 Scenarios were allowed to retire coal power plants economically in AURORA. In these three cases, low natural gas prices or high CO_2 prices tended to lower the capacity factor of coal power plants. Therefore, coal power plants which had less than a 40 percent capacity factor were allowed to retire in AURORA's long-term run. Planned retirements and AURORA-assumed retirements are shown in tables N-16 and N-17 below.

Figure N-16: Planned Coal Retirements across WECC

Planned Coal Retirement (2014 -2035)	MW
Planned Retirement (California)	1,555
Planned Retirement (Pacific Northwest, USA)	2,079
Planned Retirement (Pacific Northwest, CAN)	3,949
Planned Retirement (Rocky Mountain)	1,425
Planned Retirement (Southwest)	608
Total Planned Retirement	**9,616**

Figure N-17: Assumed Coal Retirements across WECC

Assumed Coal Retirement (2014 -2035)	MW
Assumed coal Retirement (High)	7,036
Assumed coal Retirement (Base + Low Gas)	7,245
Assumed coal Retirement (Base + High CO2)	7,432

Natural Gas-fired Power Plant Retirements. Planned natural gas power plant retirements by year and region are shown in table N-18 below. Most of the natural gas-fired power plants will retire before the end of 2025. Among the 10,869 MW retirements, 9,164 MW is in CA, which is due to Once-Through-Cooling (OTC) rules issued by the State Water Resources Board of California on May 4, 2010. The State Water Resources Board of California adopted a statewide water quality control policy on the use of Once-Through-Cooling (OTC) power plants (nuclear and non-nuclear facilities). This policy establishes requirements for the implementation of the Clean Water Act Section 316 (b), using best professional judgment in determining Best Technology Available (BTA) for cooling intake structures at existing coastal and estuarine plants. We followed the retirement/replacement schedule of the CA OTC plants from the WECC Transmission Expansion Planning Policy Committee (TEPPC) 2022 Common Case and Los Angeles Department of Water and Power (LADWP) Implementation Plan April 2011.

Figure N-18: Planned Natural Gas Retirements in WECC

Planned Nature Gas Retirement	MW
Planned Retirement (California)	9,164
Planned Retirement (Pacific Northwest, USA)	0
Planned Retirement (Pacific Northwest, CAN)	1,065
Planned Retirement (Rocky Mountain)	65
Planned Retirement (Southwest)	575
Total Planned Retirement	10,869

WECC Builds. We used the NPCC's draft 7 power plan database, but added 1,619 MW of new natural gas plant builds in WECC region, based on the data from the SNL Energy database[3] as of September 2014. Figure N-19 provides the new build capacity for each of the WECC sub-regions.

Figure N-19: Planned New Builds in WECC

MW Nameplate	California	Pacific Northwest (USA)	Pacific Northwest (CAN)	Southwest	Rocky Mountain	Total
Solar	1,694	-	-	624	110	2,428
Other Renewables	49	732*	1,421	-	-	2,202
Wind	19	267	445	-	250	981
Thermal	5,989	1,212	1,125	242	1,330	9,898
Total	7,751	2,210	2,991	866	1,690	15,508

**732 MW is the upgraded capacity for Wanapum*

Renewable Portfolio Standard (WECC). Renewable portfolio standards (RPS) currently exist in 29 states and the District of Columbia, including most of the states in the WECC and British Columbia. They affect PSE because they increase competition for development of renewable resources. Each state and territory defines renewable energy sources differently, sets different timetables for implementation, and establishes different requirements for the percentage of load that must be supplied by renewable resources.

To model these varying laws, PSE used the same method from the NPCC seventh power plan. NPCC first identifies the applicable load for each state in the model and the renewable benchmarks of each state's RPS (e.g., 3 percent in 2015, then 15 percent in 2020, etc.). Then they apply those requirements to each state's load. No retirement of existing WECC renewable resources is assumed, which perhaps underestimates the number of new resources that need to be constructed. After existing and planned renewable energy resources are accounted for, "new" renewable energy resources are matched to the load to meet the applicable RPS. Following areview for reasonableness, these resources are created in the AURORA database. Technologies included wind, solar, biomass and geothermal.

The table below includes a brief overview of the RPS for each state in the WECC that has one. The "Standard" column offers a summary of the law, as provided by the Lawrence Berkeley National Laboratory (LBNL), and the "Notes for AURORA Modeling" column includes a description of the new renewable resources created to meet the law.

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3 / SNL, which stands for Savings and Loan, is a company that collects and disseminates corporate, financial and market data on several industries including the energy sector (www.snl.com).

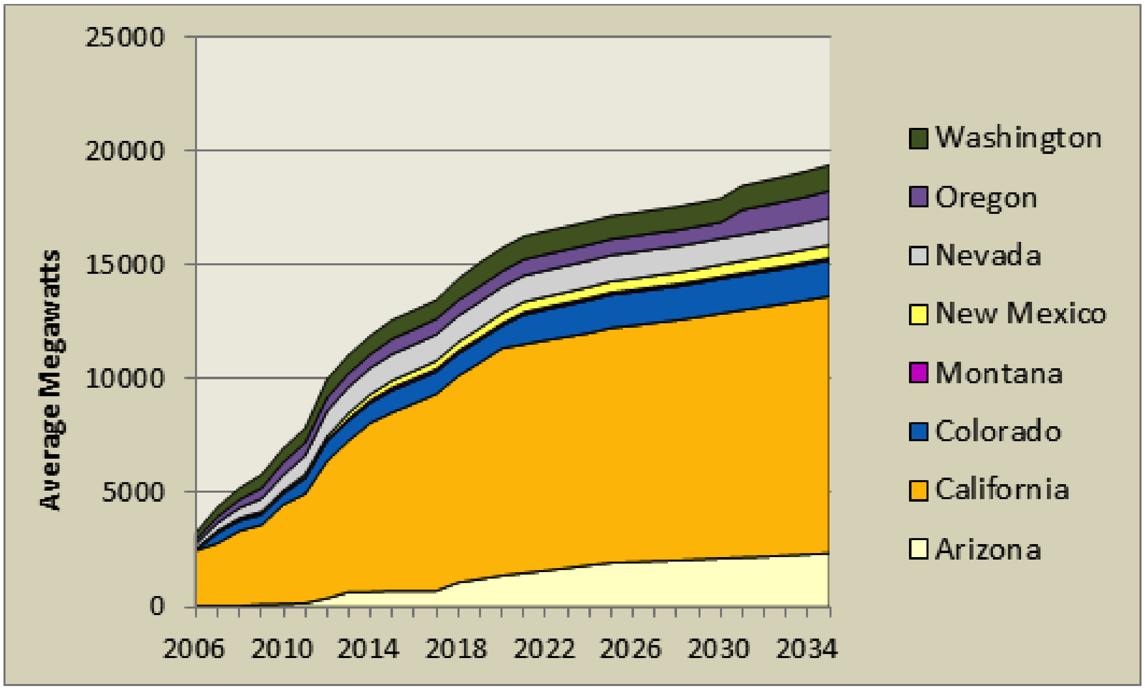
Figure N-20: RPS Requirements for States in WECC

State	Standard (LBNL)	Notes for AURORA Modeling
Arizona	New Proposed RPS: 1.25% in 2006, increasing by 0.25% each year to 2% in 2009, then increasing by 0.5% a year to 5% in 2015, and increasing 1% a year to 14% in 2024, and 15% thereafter. Of that, 5% must come from distributed renewables in 2006, increasing by 5% each year to 30% by 2011 and thereafter. Half of distributed solar requirement must be from residential application; the other half from non-residential non-utility applications. No more than 10% can come from RECs, derived from non-utility generators that sell wholesale power to a utility.	Very little potential wind generation is available. Most of the requirement is met with central solar plants. The distributed solar (30%) is accounted for by assuming central renewable energy.
British Columbia	Clean renewable energy sources will continue to account for at least 90% of generation. 50% of new resource needs through 2020 will be met by conservation.	The assumption is that a majority of this need will be met by hydropower and wind.
California	IOUs must increase their renewable supplies by at least 1% per year starting January 1, 2003, until renewables make up 20% of their supply portfolios. The target now is to meet 20% level by 2010, with potential goal of 33% by 2020. IOUs do not need to make annual RPS purchases until they are creditworthy. CPUC can order transmission additions for meeting RPS under certain conditions.	The California Energy Commission created an outline of the necessary new resources by technology that could meet the 20% by 2010 goal. Technologies include wind, biomass, solar and geothermal in different areas of the state The renewable energy resources identified in the outline were incorporated into the model.
Colorado	HB 1281 -Expands the definition of "qualifying retail utility" to include providers of retail electric services, other than municipally owned utilities, that serve 40,000 customers or less. Raises the renewable energy standard for electrical generation by qualifying retail utilities other than cooperative electric associations and municipally owned utilities that serve more than 40,000 customers to 5% by 2008, 10% by 2011, 15% by 2015, and 20% by 2020. Establishes a renewable energy standard for cooperative electric associations and municipally owned utilities that serve more than 40,000 customers of 1% by 2008, 3% by 2011, 6% by 2015, and 10% by 2020. Defines "eligible energy resources" to include recycled energy and renewable energy resources.	The primary resource for Colorado is wind. The 4% solar requirement is modeled as central power only.
Montana	5% of sales (net of line losses) to retail customers in 2008 and 2009; 10% from 2010 to 2014; and 15% in 2015 and thereafter. At least 50 MW must come from community renewable energy projects during 2010 to 2014, increasing to 75 MW from 2015 onward. Utilities are to conduct RFPs for renewable energy or RECs and after contracts of at least 10 years in length, unless the utility can prove to the PSC the shorter-term contracts will provide lower RPS compliance costs over the long-term. Preference is to be given to projects that offer in-state employees or wages.	The primary source for Montana is wind. The community renewable resources are modeled as solar units of 50 MW then 25 MW.

State	Standard (LBNL)	Notes for AURORA Modeling
Nevada	6% in 2005 and 2006 and increasing to 9% by 2007 and 2008, 12% by 2009 and 2010, 15% by 2011 and 2012, 18% by 2013 and 2012, ending at 20% in 2015 and thereafter. At least 5% of the RPS standard must be from solar (PV, solar thermal electric, or solar that offsets electricity, and perhaps even natural gas or propane) and not more than 25% of the required standard can be based on energy efficiency measures.	The Renewable Energy Atlas shows that considerable geothermal energy and solar energy potential exists. For modeling the resources are located in the northern and southern part of the state respectively, with the remainder made up with wind.
New Mexico	Senate Bill 418 was signed into law in March 2007 and added new requirements to the state's Renewable Portfolio Standard, which formerly required utilities to get 10% of their electricity needs by 2011 from renewables. Under the new law, regulated electric utilities must have renewables meet 15% of their electricity needs by 2015 and 20% by 2020. Rural electric cooperatives must have renewable energy for 5$ of their electricity needs by 2015, increasing to 10% by 2020. Renewable energy can come from new hydropower facilities, from fuel cells that are not fossil-fueled, and from biomass, solar, wind, and geothermal resources.	New Mexico has a relatively large amount of wind generation currently for its small population. New resources are not required until 2015, at which time they are brought in as wind generation.
Oregon	Large utility targets: 5% in 2011, 15% in 2015, 20% in 2020 and 25% in 2025. Large utility sales represented 73% of total sales in 2002. Medium utilities 10% by 2025. Small utilities 5% by 2025.	We followed the the NWPCC 6th Power Plan assumption for REC banking in the state of Oregon.
Utah	Utah enacted The Energy Resource and Carbon Emission Reduction Initiative (S.B. 202) in March 2008. While this law contains some provisions similar to those found in renewable portfolio standards (RPSs) adopted by other states, certain other provisions in S.B. 202 indicate that this law is more accurately described as a renewable portfolio goal (RPG). Specifically, the law requires that utilities only need to pursue renewable energy to the extent that it is "cost-effective" to do so. Investor-owned utilities, municipal utilities and cooperative utilities must meet 20% of their 2025 adjusted retail electric sales.	
Washington	Washington state RPS: 3% by 2012, 9% by 2016, 15% by 2020. Eligible resources include wind, solar, geothermal, biomass, tidal. Oregon officials have been discussing the need for an RPS.	Assumed any new generic renewables will meet the criteria for the extra 20% REC credit.

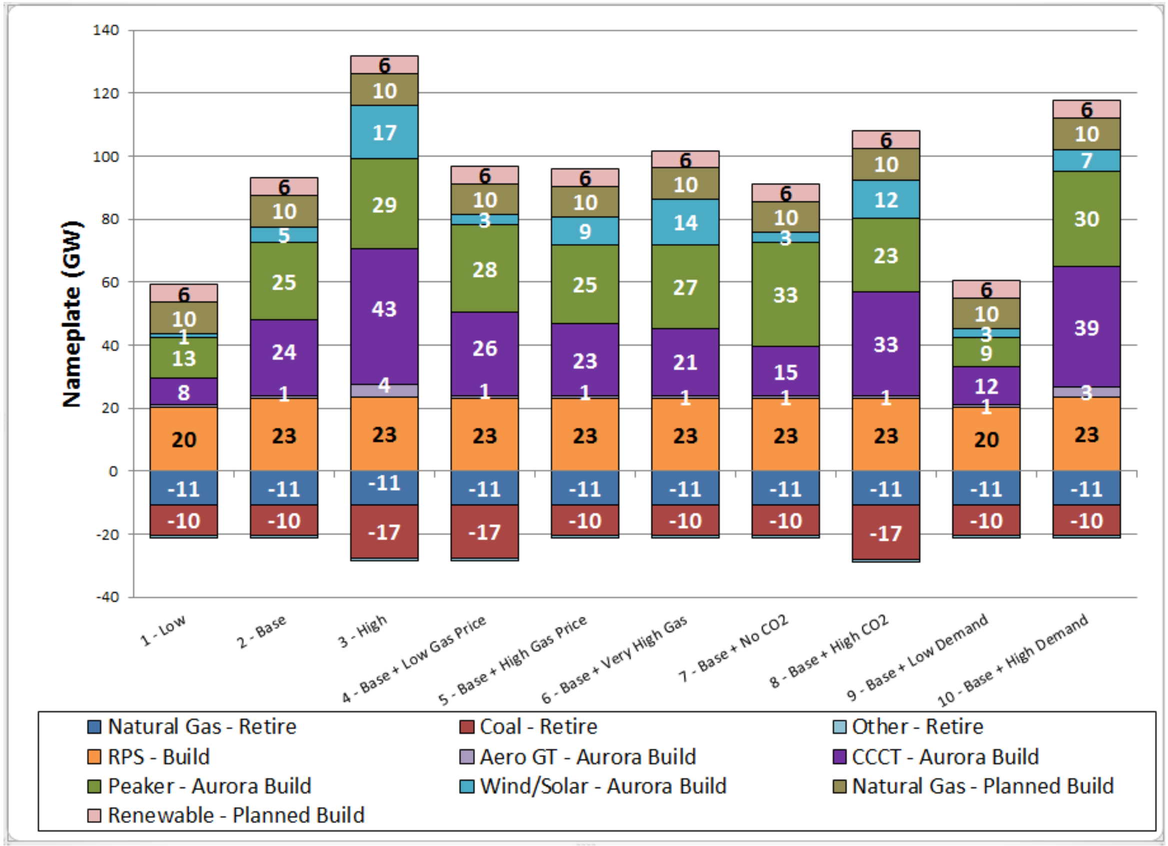
In order to reflect RPS requirements in the 20-year planning horizon, renewable resource capacities were calculated and they were treated as new resources in the AURORA resource table.

Figure N-21: RPS Builds Added to AURORA Database by State



AURORA Builds. AURORA is able to run a long-term optimization model to choose a set of available supply to meet both energy needs and peak needs. New resources are built only when the combination of hourly prices and frequency of operation for a resource generate enough revenue to make construction profitable. Figure N-21 shows AURORAxmp builds in 10 scenarios along with planned, retired and RPS capacity described above for both the U.S. and Canada WECC.

Figure N-22: WECC Total Builds/Retirements by 2035



Production Tax Credit Assumptions. The Production Tax Credit (PTC) is a subsidy identified in the American Recovery and Reinvestment Act of 2009 (ARRA) for production of renewable energy. In January 2013, the American Taxpayer Relief Act of 2012 (H.R. 6, Sec. 407) removed the "placed in service dates" for eligibility and replaced this language with "begins construction in 2013." Currently, the PTC amounts to approximately $22 (in 2012 dollars) per MWh for 10 years of production after a project is placed into service. The PTC is indexed for inflation. The Base Scenario assumes no further PTCs are available for new resource development as of 2014.

Investment Tax Credit Assumptions. The Investment Tax Credit (ITC) currently amounts to 30 percent of the eligible capital cost for renewable resources; it expires at the end of 2013. These scenarios assume no extension of ITCs.

Treasury Grant Assumptions. The Treasury Grant (Grant) is subsidy that amounts to 30 percent of the eligible capital cost for renewable resources; it also expires at the end of 2013. For projects placed in service in 2013, construction must have started in 2009, 2010, or 2011 and the project must meet eligibility criteria. This subsidy differs from the previous two in that it is a cash payment from the federal government, versus a tax credit. No extension of the Treasury Grant is assumed.

PSM III Inputs

Renewable Portfolio Standard (PSE). The current PSE resources that meet the Washington state RPS include Hopkins Ridge, Wild Horse, Klondike III, Snoqualmie Upgrades, Lower Snake River I and Lower Baker Upgrades. The Washington state RPS also gives an extra 20 percent credit to renewable resources that use apprenticeship labor. That is, with the adder, a resource can contribute 120 percent to RCW 19.285. The PSE resources that can claim the extra 20 percent are Wild Horse Expansion, Lower Snake River I and Lower Baker Upgrades. For modeling purposes, we assume that the generic wind receives the extra 20 percent.

Discount Rate. We used the pre-tax weighted average cost of capital (WACC) from the 2013 Expedited Rate Filing (ERF) of 7.77 percent nominal or 6.7 percent after-tax.

REC Price. The REC price starts at $4.25 per MWh in 2016 and escalates to $14.85 per MWh in 2035. The escalation rate is not uniform for the whole 20-year planning horizon. A major increase occurs in 2020 with an approximate 124 percent increase, corresponding to the RPS increase. All other years use a 2.5 percent escalation.

Inflation Rate. The 2015 IRP uses a 2.5 percent escalation for all assumptions unless otherwise noted. This is the long-run average inflation rate that the AURORAxmp model uses.

Transmission Inflation Rate. In 1996, the BPA rate was $1.000 per kW per year and the estimated total rate in 2015 is $1.798 per kW per year. Using the compounded average growth rate (CAGR) of BPA Point-to-Point (PTP) transmission service (including fixed ancillary service Scheduling Control and Dispatch) from 1996 to 2015, we estimated the nominal CAGR inflation rate to be 3.05 percent annually.

Gas Transport Inflation Rate. Natural gas pipeline rates are not updated often and recent history indicates that the rates have been increasing at approximately 1.25 percent annually.

Resource Adequacy Models and Planning Standard

The primary objective of PSE's capacity planning standard analysis is to determine the appropriate level of planning margin for the utility. Planning margin for capacity is, in general, defined as the level of generation resource capacity reserves required to provide a minimum acceptable level of service reliability to customers under peak load conditions. This is one of the key constraints in any capacity expansion planning model, because it is important to maintain a uniform reliability standard throughout the planning period in order to obtain comparable capacity expansion plans. The planning margin (measured in MW) is determined as:

Planning Margin = (Generation Capacity – Normal Peak Loads)/Normal Peak Loads.

The planning margin framework allows for the derivation of multiple reliability/risk metrics (such as the likelihood, magnitude and duration of supply-driven customer outages) that, in turn, can be used to quantify the relative capacity contributions of different resource types (thermal, wind, energy storage, wholesale market purchases, etc.) towards meeting PSE's firm peak loads.

PSE's Resource Adequacy Model (RAM). PSE developed its probabilistic Resource Adequacy Model to quantify physical supply risks as PSE's portfolio of loads and resources evolves over time. This model provides the framework for establishing peak load planning standards, which in turn leads to the determination of PSE's capacity planning margin. The RAM is also utilized to compare the relative capacity contribution of supply-side resources that are subject to random production patterns and to express those contributions in equivalent terms (i.e. incremental capacity equivalents or ICE). Since PSE is a winter-peaking electric utility, its capacity planning standard and associated planning margin are based upon its forecasted ability to reliably meet winter season firm peak loads.

In previous IRPs, PSE has treated its reliance on wholesale market purchases as a known and firm capacity resource in its resource adequacy model; in other words, wholesale market purchases were assumed to be available in any amount at any time. This assumption was primarily based upon the NW Regional Resource Adequacy Forum's finding that the Pacific Northwest had adequate resources available to meet the region's peak load planning standard for approximately the next five to seven year period. However, with the impending closure of the 585 MW Boardman coal plant and the 730 MW Centralia Unit 1 in 2020 followed by the closure of the 730 MW Centralia Unit 2 in 2025, the Northwest Power and Conservation Council's Resource Adequacy Advisory Committee has determined that the region could be capacity deficient in the winter of 2020-21 based upon the results of the Council's GENESYS regional resource adequacy model. Given this assessment, PSE updated its resource adequacy model to make it more consistent with the assumptions incorporated into the NPCC's regional resource adequacy model, especially with respect to assumptions regarding the firmness of PSE's wholesale market purchases under peak load conditions. Appendix G provides a more detailed discussion of how the market reliance-related inputs into PSE's resource adequacy model were developed.

Consistency with Regional Resource Adequacy Assessments.

Consistency with the NPCC's regional probabilistic GENESYS resource adequacy model is needed in order to ensure that the conditions under which the region may experience capacity deficits are properly reflected in PSE's modeling of its own loads, hydro and thermal resource conditions in the RAM. The PSE resources included in this analysis are Colstrip, Mid-Columbia purchase contracts and western Washington hydroelectric resources, several gas-fired plants (simple-cycle and combined-cycle combustion turbines), long-term firm purchased power contracts, several wind projects, and short-term wholesale (i.e., "spot") market purchases up to PSE's available firm transmission import capability from the Mid-C.

The multi-scenario simulations made in PSE's resource adequacy model are consistent with the 6,160 simulations made in the NPCC's GENESYS model in terms of temperature, hydro conditions and thermal outage rates. In addition, PSE's RAM utilizes the same October 2020 – September 2021 study period as the regional GENESYS model.

The following sources of uncertainty were incorporated into PSE's multi-scenario RAM.

1. **FORCED OUTAGE RATE FOR THERMAL UNITS** – modeled as a combination of an outage event and duration of an outage event, subject to mean time to repair and total outage rate equal to the values used in GENESYS.

2. **HOURLY SYSTEM LOADS** – modeled as an econometric function of hourly temperature for the month, and using the hourly temperature data for each of the 77

temperature years from 1929 to 2005 to preserve its chronological order, consistent with the GENESYS model. Loads are further adjusted for conservation savings where the weather-sensitive savings vary by the temperature simulation.

3. MID-COLUMBIA AND BAKER HYDROPOWER – PSE's RAM uses the same 80 hydro years, simulation for simulation, as the GENESYS model. PSE's Mid-Columbia purchase contracts and PSE's Baker River plants are further adjusted so that: 1) they are shaped to PSE load, and 2) to account for capacity contributions across several different sustained peaking periods (a 1-hour peak up to a 12-hour sustained peak). The 6,160 combinations of hydro and temperature simulations are consistent with the GENESYS model.

4. WHOLESALE MARKET PURCHASES – These inputs to the RAM are determined in the Wholesale Purchase Curtailment Model (WPCM) as explained in Appendix G. Limitations on PSE wholesale capacity purchases resulting from regional load curtailment events (as determined in the WPCM) utilize the same GENESYS model simulations as PSE's RAM.

5. WIND – drawn randomly from historical hourly data for PSE's Wild Horse and Hopkins Ridge plants, but constrained for the following: 1) simulations of daily 24-hour wind profiles are made each month with each day having an equal probability of being chosen until all days in the month are populated to preserve seasonality; 2) simulations across wind farms are synchronized on a daily basis to preserve any correlations that may exist between Hopkins Ridge and Wild Horse; 3) PSE's Lower Snake River wind farm, which does not yet have a long-term generation data record, is assumed to have the same wind profile as Hopkins Ridge, with a 10-minute lag since it is located near Hopkins Ridge, and is scaled to its nameplate capacity and pro-forma capacity factor.

Treatment of Operating Reserves in the RAM. PSE is required to maintain contingency reserves pursuant to the Northwest Power Pool (NWPP) reserve sharing agreement. Members are required to hold 3 percent of load and 3 percent of on-line dispatched generation in reserve, in case any member experiences an unplanned generating plant outage. In the event of an unplanned outage, NWPP members can call on the contingency reserves held by other members to cover the loss of the resource during the 60 minutes following the outage event. After the first 60-minute period, the member experiencing the outage must return to load-resource balance by either re-dispatching other generating units, purchasing power, or curtailing load. PSE's RAM reflects the value of contingency reserves to PSE by ignoring the first hour of a load curtailment, if a forced outage at one of PSE's generating plants causes loads to exceed available resources.

PSE's planning margin is calculated net of operating reserves, which are the sum of contingency reserves (as described above) and within-hour balancing resources. The total amount of contingency reserves and balancing reserves maintained by PSE can vary depending upon the magnitude of the resources and loads located in the PSE balancing authority area, and the generating capacity needed to meet short-term system flexibility requirements.

Risk Metrics. The probabilistic resource adequacy model (RAM) allows for the calculation of several risk metrics including: 1) the loss of load probability (LOLP) which measures the likelihood of a load curtailment event occurring in any given simulation, 2) the expected unserved energy (EUE) which measures magnitude in Mwh and is the sum of all unserved energy/load curtailments across all hours and simulations divided by the number of simulations, and 3) loss of load hours (LOLH) which measures duration and is the sum of the hours with load curtailments divided by the number of simulations. Capacity planning margins and incremental capacity equivalents for different resources can be defined using any of these three risk metrics, once a planning standard has been established.

Determining PSE's Capacity Planning Margin. As described in Chapters 2 and 6, this IRP utilizes a new planning standard that optimizes the value of reliability to customers while incorporating wholesale market purchase risk.[4] The 2015 Optimal Planning Standard utilizes the expected unserved energy (EUE) since this metric provides a quantifiable measure (in MWh) of the magnitude of load curtailment events, which in turn serves as the basis for determining the financial impacts of outages on PSE's customers through a value of lost load (VOLL) computation. By comparison, the 2013 planning standard utilized a LOLP target metric (which provides no information about either the magnitude or duration of customer curtailment events), and furthermore, it did not incorporate wholesale market purchase risk.[5]

Value of Lost Load. Value of lost load (VOLL) is utilized in the 2015 Optimal Planning Standard to determine the optimal EUE target for the PSE system based upon an evaluation of the cost of adding generating resources to increase service reliability compared to the cost to customers of potential outages. In other words, VOLL quantifies the benefit to customers of experiencing a higher level of electric service reliability, so that it can be compared to the cost of providing that level of reliability.

4 / Subsequent references to the "2015 Optimal Planning Standard" in this Appendix infer that wholesale market purchase risk is incorporated into the standard.
5 / Subsequent references to the "2013 Planning Standard" in this Appendix infer that wholesale market purchase risk is not incorporated into the standard.

VOLL is typically derived from customer surveys. A well-designed survey is sometimes difficult to implement since the cost/value placed on an electric service interruption by a customer could be biased by a number of factors, plus these values could change over time and/or be seasonal in nature. Also, different types of customers (i.e. industrial, commercial, residential) are likely to have significantly different assessments of the value of avoiding a service interruption.

Notwithstanding the above issues, VOLL is a critical input for electric utilities in determining the appropriate EUE-based target for long-term peak load planning. A lower EUE target implies a smaller magnitude and lower expected frequency of load curtailments and therefore a higher level of reliability, but this condition can only be achieved by investing in additional capacity resources. Increasing investment to achieve higher system reliability must be balanced against the benefits that customers gain from a reduced probability of load curtailments. The point where the incremental benefits of increasing reliability (the marginal benefits) equals the associated incremental costs (marginal costs) of adding more firm capacity determines the “correct” or “optimal” EUE target level.

VOLL for the PSE System. The value of lost load for PSE was derived from the US Department of Energy’s (DOE) Interruption Cost Estimator (ICE Calculator) which was based on the Lawrence Berkeley Laboratory study titled “Updated Value of Service Reliability for Electric Utility Customers in the United States," by Michael J. Sullivan, Ph.D., Josh Schellenberg, and Marshall Blundell, Nexant, Inc., Ernest Orlando Lawrence Berkeley National Laboratory LBNL-6941E, June 2009. This study provided estimates of interruption costs per customer for each event and length of outage duration by customer class (residential, small commercial and industrial, medium and large commercial and industrial), for each of the states in the U.S. The challenge for PSE was in converting these customer class outage cost estimates – as reported on a per MW loss basis by outage duration – into aggregated system-wide metrics for use in the RAM (which analyzes the PSE system as a whole and not by individual customer class). However, the DOE’s ICE Calculator provides a mechanism for estimating the average annual energy consumption by customer class. Coupled with PSE’s assumptions about load factors and customer class contribution to peak load,[6] one can calculate a per-customer peak load contribution (measured in kW), averaged across all customer classes. This value was then used to compute the expected number of PSE customers affected by a given load curtailment event.

Next, an average interruption cost per event across all customer types was calculated for each event duration as identified in DOE’s ICE Calculator (i.e., durations of 1 hour, 2 hours,…, 8 hours and above). In performing these computations, we applied the interruption cost for the 8 hours and above duration for any event with duration of 8 or more hours. The interruption costs by

6 / Customer Peak Load Shares – from the PSE Rate Department’s “Peak Contribution by Rate Class, Dec 2010” customer class in Washington State were inflation adjusted to the 2020 study period. To obtain an average interruption cost across all customer classes, we used PSE's estimated customer class contribution to winter peak load shares. This average interruption cost per event by duration reflects customers' value of lost load since this is the cost that would be avoided in the absence of a load outage. For each duration length, this value is multiplied by the unserved energy for each curtailment event. Figure N-22 below shows the VOLL for an average PSE customer for a one-hour outage duration.

Figure N-23: Interruption Cost Calculation of an Average PSE Customer per Event of One-hour Duration

Customer Type	Number of Customers	Per Customer InterrCost per Event - 2011$	Per Customer InterrCost per AvgKW/Hr - 2011$	Implied Avg KW per Yr(Flat)	PSE Load Factors	Peak KW/Yr	PSE Peak Shares	Avg Peak per Yr per Cust, KW
	Year End 2020	1HR Duration	1HR Duration					
Medium&Large C&I	10,889	$4,122.40	$27.80	148.3	1.47	218	0.2	43.6
Small Comm&Ind	126,531	$758.90	$179.70	4.2	1.42	6	0.1	0.6
Residential	1,060,975	$2.80	$1.90	1.5	2.05	3	0.7	2.1
All Customers	1,198,395	$120.06	$38.76	3.1	1.71	5.3		**46.3**
Interr Cost Aver Per Cust per Hr($2020)		$149.94						

The implied 2020 per customer interruption cost from Figure N-22 is $3.24 per kWh (equal to $149.94 per customer for a one-hour outage event divided by an average peak load of 46.3 kW per customer). The hourly per-customer interruption cost increases as the duration of the outage increases, but at a declining rate, and it declines slightly after the duration exceeds 7 hours.

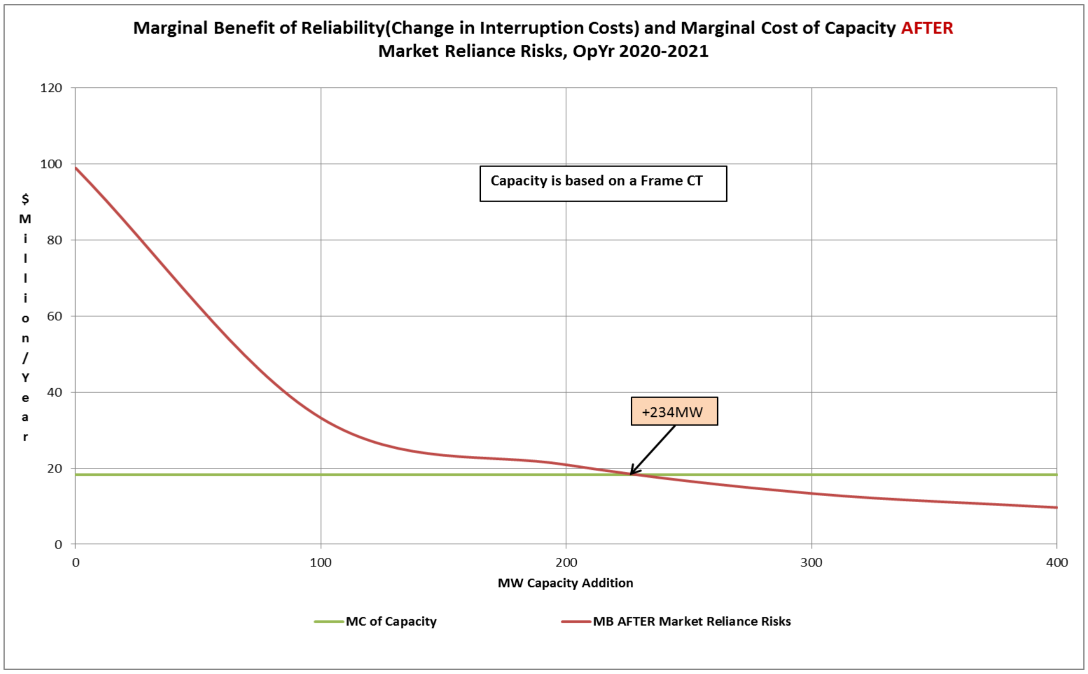
Optimizing Customer Reliability Benefits. The customer value of lost load is summed across all curtailment events in the year, and then averaged over 6,160 simulations to get the expected annual value of lost load for any given level of EUE. As we add gas-fired peaking plants to PSE's portfolio in increments of 100 MW, service reliability increases which results in lower calculated levels of EUE and VOLL. The reduction in the VOLL (measured in dollars) for the PSE system as new capacity is added to the portfolio is the marginal benefit of reliability. The relationship between the annual value of lost load and lower EUE (i.e., increasing reliability) as new peaking plant capacity is added can be shown as a downward sloping curve; alternatively, the incremental benefit of increasing reliability is positive but a declining function of the added capacity.

In this study, to achieve different levels of EUE, a gas-fired simple-cycle CT is added to the system since previous IRPs have shown this is the cheapest generation technology available to meet PSE's peak load needs. The present value of the net costs[7] of the incremental peaking plant is levelized over its life and the life of a replacement peaker to obtain an annualized peaker cost on a per MW basis, expressed in 2020 dollars. These costs were obtained from PSE's PSM model using 2015 IRP assumptions. Given these costs, an upward sloping curve is derived showing the relationship between annual costs of the total peaking capacity added and the associated EUE levels for PSE's system. The incremental cost of increasing reliability, however, is a flat line since the annualized cost per MW of adding additional peaking capacity is constant.

Figure N-24 shows the marginal benefit and marginal cost of reliability as new generating capacity is added and reliability is increased (and EUE declines) before and after incorporating wholesale market purchase risk. The intersection points of the horizontal cost line and the downward sloping benefit curves determines the optimal level of EUE since these points represent the minimum total costs of reliability (VOLL + resource costs). Reflecting wholesale market purchase risk in the study results in more occurrences and higher volumes of PSE load curtailments, therefore the value of lost loads in this case is higher. Consequently, the marginal benefit of increasing reliability by adding capacity is higher compared to ignoring wholesale market purchase risks. Thus, PSE's optimal level of capacity additions, based on its customers' value of lost load, is higher after reflecting wholesale market purchase risk.

7 / Net cost = fixed costs + variable costs – revenue + end effects + replacement costs

Figure N-24: Customer VOLL Optimal Capacity Additions



The VOLL-based optimal capacity additions imply different EUE levels compared to the 5 percent LOLP standard that was used in the 2013 IRP. Because the 5 percent LOLP target utilized in the 2013 Planning Standard does not account for the optimal level of customer reliability, the EUEs implied are higher (which indicates lower reliability) as compared to the EUEs obtained by the 2015 Optimal Planning Standard in which customers' VOLL and the costs of increasing reliability are accounted for. Figure N-25 compares the 2013 Planning Standard, the 2013 Planning Standard with wholesale market risk, and the 2015 Optimal Planning Standard.

Figure N-25: Comparison of the 2013 Planning Standard, the 2013 Planning Standard with Wholesale Market Risk, and the 2015 Optimal Planning Standard

	LOLP	EUE (MWh)	Planning Margin	2021 Capacity Added (MW)	Expected VOLL ($mill/yr)	TVar90 VOLL ($mill/yr)
2013 Planning Standard	5%*	26	13%	(150)	86	858
2013 Planning Standard with Market Risk	5%*	50	13.8%	(117)	169	1,691
2015 Optimal Planning Standard	1%	10.9*	20.0%	234	39	385

** Target Metric*

Figure N-25 also shows the different risk metrics for the different planning standards. The following key conclusions can be derived from these results.

1. After reflecting wholesale market risk, the change in capacity needed to maintain the 2013 Planning Standard's 5 percent LOLP target is small (from -150 MW to -117 MW); however, this is because the LOLP target focuses only the frequency or likelihood of load curtailments. Expected unserved energy (EUE) more than doubles, from 26 MWh to 50 MWh, indicating a significant increase the magnitude of potential load curtailments. Note that PSE's portfolio is surplus under the 5 percent LOLP target, hence, the negative capacity adjustments needed to maintain this standard.

2. The EUEs implied by the 2013 Planning Standard's 5 percent LOLP target are higher than those based on customers' optimal value of reliability because the 5 percent LOLP target ignores the additional benefits and costs of higher or lower levels of customer reliability .

3. The change in planning margin is small between the 2013 Planning Standard and the 2013 Planning Standard with market risk case since the change in capacity needed to maintain the 5 percent LOLP is small (33 MW=(-117 MW - -150 MW).

4. Figure N-24 also shows the expected VOLL and the TailVar90 of VOLL for the 2013 Planning Standard, the 2013 Planning Standard with wholesale market risk, and the 2015 Optimal Planning Standard. The expected VOLLs under the 2013 Planning Standard and the 2013 Planning Standard with market risk (5 percent LOLP) are always higher than the 2015 Optimal Planning Standard (customer optimal level of reliability).. This is because the EUEs from the 2013 Planning Standard and 2013 Planning Standard with market risk are higher, or the implied customer reliability levels are lower. The change in the

TailVar90 also shows the potential magnitude of further risk reduction as a result of adopting the customer optimal reliability metric.

5. The gross benefit to PSE's customers of increasing reliability under the 2015 Optimal Planning Standard – by adding 234 MW of gas-fired CT generating capacity to PSE's resource portfolio and reducing annual EUE from 50 MWh to 10.9 MWh – is $130 million per year, while the cost associated with the added capacity is $63 million per year. The net benefit to customers of increasing reliability is therefore $67 million per year. As discussed, this represents the economically efficient point where marginal benefits equals marginal costs; adding more or less new capacity to the portfolio would result in a lower level of net benefits to customers.

While the 2015 Optimal Planning Standard adopted by PSE in this IRP includes wholesale market purchase risk by definition, it may also be instructive to view the risk metrics of an alternate case that does not include the impacts of market risk. These metrics are summarized in Figure N-25. Note, by ignoring wholesale market risk, the VOLL and capacity additions need to maintain a 3 MWh EUE are both significantly understated, which is apparent when comparing to Figure N-25, above.

Figure N-26: 2015 Optimal Planning Standard without Wholesale Market Risk

	LOLP	EUE(MWh)	Planning Margin	2021 Capacity Need (MW)	Expected VOLL $mill/yr	TVar90 VOLL $mill/yr
2015 Optimal Planning Standard without Market Risk	1.7%	**3**	17.7%	97	10	96
	Target Metrics					

The following key conclusions can be derived from the results shown in Figures N-25 and N-26:

1. Before reflecting wholesale market purchase risk in the 2015 Optimal Planning Standard but still accounting for customers' benefits and costs of reliability (by linking customer interruption costs to VOLL and the resource costs associated with increasing reliability) leads to a lower EUE (from 26 MWh to 3 MWh) and lower LOLP (from 5.0 percent to 1.7 percent). The EUE of 3 MWh is associated with the optimal capacity addition of 97 MW as indicated in Figure N-26.

2. After reflecting wholesale market purchase risk, the optimal EUE for the 2015 Planning Standard is higher because the higher levels of risk require higher expenditures to maintain the desired reliability. Thus, the optimal EUE level rises from 3 MWh to 10.9 MWh. (10.9 MWh of EUE is obtained by adding 234 MW of capacity to the existing portfolio.) At the optimal EUE levels, the associated LOLPs are lower than 5 percent (1.7 percent for the 2015 Optimal Planning Standard excluding wholesale market risks and 1.0 percent for the 2015 Optimal Planning Standard).

3. For the 2015 Optimal Planning Standard (which is based upon the optimal EUE level), the capacity addition needed to obtain the customer optimal reliability level is 137 MW higher (= 234 MW – 97 MW) than in the 2015 Optimal Planning Standard without wholesale market risk case. Therefore, the planning margin rises from 17.7 percent to 20.0 percent (referenced to 2021 conditions).

Incremental Capacity Equivalents of Resources. The incremental capacity credits assigned to PSE's existing and prospective resources were developed by applying the incremental capacity equivalent (ICE) approach[8] in the RAM. In essence, the ICE approach identifies the equivalent capacity of a gas-fired peaking plant that would yield the same customer optimal EUE level as the capacity of a different resource such as a wind farm, energy storage facility, Colstrip or wholesale market purchases using PSE's available firm Mid-C transmission import rights. The ratio of the equivalent gas peaker capacity to the alternative resource capacity is the incremental capacity equivalent (ICE); this value represents the capacity credit assigned to the alternative resource. For the 2015 IRP, ICE was calculated for existing and new wind projects, the Colstrip plant, and for wholesale market purchases.

8 / The ICE approach is similar to the equivalent load carrying capability (ELCC) approach, except that the numeraire is a peaker instead of load in the case of ELCC.

WIND CAPACITY. In order to implement the ICE approach for wind in the RAM, the distribution of hourly generation for each of the existing and prospective wind farms was developed. These are described in this Appendix in the Stochastic Portfolio Model section under the heading "Wind Generation." Given these distributions, the wind farms were incrementally added into the RAM to determine the reduction in peaking plant capacity needed to achieve the optimal EUE level. The ratio of the change in gas peaker capacity with and without the incremental wind capacity is that wind farm's capacity credit. The order in which the existing and prospective wind farms were added in the model follows the timeline when these wind farms were acquired or about to be acquired by PSE: 1) Hopkins Ridge, 2) Wild Horse, 3) Klondike, 4) Lower Snake River, and 5) a generic wind resource expected to be located in southeast Washington close to the Lower Snake River project. However, the ICE values for the existing wind projects were not very different from each other so a single ICE value was assigned to all these wind projects.

COLSTRIP CAPACITY. The ICE for PSE's ownership share of Colstrip Units 1-4 (which have an aggregate nameplate capacity of 657 MW) was similarly calculated. PSE's share of the Colstrip plant was taken out of the resource stack, which resulted in a higher level of EUE. Peakers were then added to replace Colstrip until the customer-optimal EUE levels were achieved. The ratio of the additional peaker MW to PSE's total Colstrip capacity is its capacity credit; this value reflects the fact that the Colstrip units have historically had a higher forced outage rate than a generic gas-fired peaking plant.

WHOLESALE MARKET PURCHASES CAPACITY. With the reliability of wholesale market purchases now reflected in PSE's RAM, we applied the same analytical process to estimate the capacity value of wholesale market purchases.

To calculate the ICE of wholesale market purchases we started with a portfolio that produces the RAM results needed to achieve the planning standard target; the 2015 Optimal Planning Standard used in this IRP results in an optimal EUE level of 10.9 MWh. This involved a three-step process:

1. Introduce uncertainty in PSE's wholesale market capacity purchase volumes based upon the outputs of the WPCM as described in Appendix G. The regional resource configuration used for this step is reflected in Wholesale Market Reliability Scenario 7: NPCC's May 2015 assumptions + PGE Carty 2 + 475 MW additional CA imports, minus the 650 MW Grays Harbor plant.
2. Re-run the RAM to identify the impact on EUE. The EUE that reflects wholesale purchase risk is greater than the EUE computed under the assumption that PSE can purchase up to 1,666 MW of firm capacity in the regional wholesale markets at all times.
3. Calculate the amount of gas-fired peaking plant capacity needed to restore the system to the target level of EUE.

Summary of Resource Capacity Contributions. The table in Figure N-27 compares the incremental capacity equivalence of resources calculated using the 2013 Planning Standard (based on a 5 percent LOLP target and ignoring wholesale market risk) and the 2015 Optimal Planning Standard (which utilizes the EUE metric and includes market risk).

Figure N-27: Incremental Capacity Equivalent (ICE) Values/Capacity Credits

	2013 Planning Standard	2015 Optimal Planning Standard		
Resource Type	ICE	Nameplate Capacity (MW)	Capacity Needed to Maintain Optimal EUE	ICE
Baseline: Natural Gas Peaker	**100%**			**100%**
1) Existing Wind (Cumulative = 822MW)	12%	822	76	9%
2) New Wind (SE Washington = 100MW)*	8%	100	8	8%
3) Colstrip	92%	657	591	90%
4) Available Mid-C Transmission (Wholesale Market Purchases)	100%	1,666	269	84%

The ICE values/capacity credits from Figure N-27 are used in PSE's portfolio selection model. The above results are highly dependent on PSE's resource mix, load characteristics and projected distributions of wind generation.

Adjusted Planning Margin. Applying a 20.0 percent planning margin (as shown in Figure N-24 for the 2015 Optimal Planning Standard) to PSE's forecasted 2021 winter peak load yields a planning margin value of 1,059 MW. While this computation yields a numerically correct result for 2021, we recognized that applying the 20.0 percent figure in subsequent years might overstate PSE's planning margin, due to the fact that the 269 MW ICE adjustment shown in Figure N-26 for wholesale market purchases would not be expected to increase over time at PSE's peak load growth rate. Therefore, the planning margin was adjusted from a single 20.0 percent value to 13.7 percent plus a fixed 269 MW capacity adjustment (where the 269 MW figure reflects the wholesale market purchase risk component). This two-stage adjusted planning margin yields the same 1,059 MW value for 2021; this result is shown in Figure N-28.

Figure N-28: Calculation of PSE's 2021 Planning Margin

	Option A	Option B
Planning Margin (% of Normal Peak Load)	20%	13.7%
Wholesale Market Purchase Risk Adjustment	0 MW	269 MW
Total Capacity Above Normal Peaker	1,059 MW	1,059 MW

This planning margin and the ICE value for wholesale market purchases is expected to vary each year, as we update our information about regional resource adequacy.

OUTPUTS

AURORA Electric Prices and Avoided Costs

The series of tables below shows the AURORA price forecasts for each of the 10 scenarios. Consistent with WAC 480-107-055, this schedule of estimated Mid-Columbia (Mid-C) power prices is intended to provide only general information to potential bidders about the avoided costs of power supply. It does not provide a guaranteed contract price for electricity.

Figure N-29: Monthly Flat Mid-C Prices (Nominal $/MWh)

Base Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	38.86	39.60	38.08	33.85	32.42	33.28	35.75	38.02	40.17	40.01	40.20	38.98	37.43
2017	40.37	40.89	39.35	35.04	34.66	34.84	36.76	39.26	41.29	41.48	41.64	40.54	38.84
2018	41.82	42.65	40.77	36.66	34.20	34.88	38.22	40.83	43.30	43.21	43.00	42.68	40.19
2019	43.60	44.40	42.34	37.93	36.57	36.53	39.87	42.57	45.45	45.66	44.99	44.83	42.06
2020	45.16	46.20	44.28	40.38	37.22	38.63	41.82	44.57	47.80	47.86	47.58	46.77	44.02
2021	47.73	49.45	47.06	42.96	40.85	41.76	44.59	47.61	51.33	51.28	51.15	49.71	47.12
2022	50.20	51.87	49.05	44.93	41.95	43.52	46.87	50.46	53.51	54.35	54.10	52.23	49.42
2023	53.05	54.13	50.67	46.48	45.16	45.55	48.84	52.52	55.28	56.39	56.13	54.59	51.57
2024	55.89	57.10	53.36	49.19	45.48	46.55	51.35	54.94	58.27	59.02	57.83	57.11	53.84
2025	57.67	59.14	56.18	51.23	48.95	49.26	53.51	57.77	62.23	62.35	61.60	61.12	56.75
2026	64.41	66.87	64.75	59.25	53.98	56.74	61.65	66.39	72.28	72.57	71.93	69.49	65.03
2027	70.01	72.53	65.76	59.90	56.89	58.24	62.79	68.02	73.50	73.43	73.39	70.78	67.10
2028	71.27	73.96	67.64	61.17	57.10	59.34	64.62	70.20	75.11	76.36	75.55	72.72	68.75
2029	74.21	76.56	71.71	64.99	61.94	62.14	67.91	73.67	79.34	79.44	77.84	77.00	72.23
2030	77.32	80.17	73.55	66.72	61.36	63.27	70.21	75.46	81.90	81.88	80.47	80.53	74.40
2031	79.60	82.28	76.08	69.16	66.11	66.69	72.65	78.17	83.75	84.06	83.50	82.81	77.07
2032	82.12	84.52	78.63	71.21	65.16	68.68	75.54	81.11	86.54	86.78	86.74	85.30	79.36
2033	85.53	87.80	81.70	73.42	71.16	71.91	78.57	84.71	89.69	90.78	90.26	88.16	82.81
2034	89.41	91.44	85.23	77.61	72.72	74.84	82.28	87.94	92.89	94.59	93.75	91.98	86.22
2035	92.62	94.90	88.68	81.43	77.45	77.38	85.53	91.56	96.10	96.80	96.13	95.84	89.53

Monthly Flat Mid-C Prices
(Nominal $/MWh)

Low Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	28.49	28.25	25.65	24.40	22.77	22.59	25.96	29.02	30.18	29.81	29.56	28.96	27.14
2017	30.34	30.22	28.27	26.25	26.41	26.28	28.81	32.17	32.97	32.82	32.62	31.99	29.93
2018	30.53	30.74	28.94	26.47	25.27	25.67	28.77	32.64	33.69	33.18	32.91	33.12	30.16
2019	30.93	31.09	28.98	26.86	26.11	25.30	28.64	32.05	33.67	32.95	32.08	32.54	30.10
2020	33.46	33.43	30.68	28.34	26.21	26.84	29.84	33.72	35.73	34.57	34.26	34.50	31.80
2021	35.81	36.30	32.29	29.55	28.07	28.60	31.61	35.82	37.61	36.95	36.89	36.45	33.83
2022	36.32	36.86	34.03	30.61	28.07	29.39	32.99	37.30	39.36	38.96	39.31	39.04	35.19
2023	35.08	35.41	32.38	28.98	27.27	27.02	30.85	35.34	36.87	36.66	37.09	36.19	33.26
2024	37.41	38.09	34.44	31.31	27.68	28.30	33.87	38.24	41.01	40.97	40.22	39.38	35.91
2025	40.00	40.72	36.85	33.68	31.17	31.09	35.84	40.63	43.71	43.05	43.18	43.08	38.58
2026	41.22	41.90	39.66	36.18	31.93	33.76	38.60	43.50	46.34	45.36	45.41	44.66	40.71
2027	44.53	45.15	40.09	36.39	33.59	34.67	39.10	44.33	46.60	45.56	46.38	45.29	41.81
2028	45.35	45.92	41.07	36.62	33.04	34.90	40.03	45.65	47.30	46.83	47.75	46.59	42.59
2029	48.06	48.48	44.09	39.13	36.92	37.06	42.61	49.14	51.09	50.12	49.80	50.17	45.56
2030	48.35	48.64	43.40	38.92	34.78	35.92	42.33	48.56	50.94	49.63	49.86	51.00	45.19
2031	50.15	49.77	44.93	40.96	37.93	38.44	43.90	50.84	53.45	51.43	50.36	50.38	46.88
2032	52.47	51.96	46.70	42.81	38.33	40.51	46.16	53.63	55.57	53.46	53.07	52.47	48.93
2033	54.43	54.13	48.89	44.35	41.97	42.88	47.88	56.25	57.93	55.83	55.39	54.57	51.21
2034	56.97	56.32	50.86	46.02	41.98	44.34	50.05	58.49	60.08	58.40	58.03	56.80	53.19
2035	59.54	59.00	53.12	48.02	45.56	45.88	52.07	61.23	63.65	61.42	59.87	59.72	55.75

Monthly Flat Mid-C Prices
(Nominal $/MWh)

High Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	36.58	36.16	32.78	31.62	30.79	31.19	33.94	37.20	38.30	38.62	37.88	37.27	35.19
2017	38.41	38.14	35.98	33.91	35.11	35.17	37.89	41.45	41.58	41.82	41.39	40.83	38.47
2018	41.62	41.96	39.73	36.38	36.19	36.86	40.60	45.10	45.66	45.69	45.24	45.54	41.71
2019	48.10	48.32	45.09	41.90	42.14	41.51	46.30	50.61	51.78	51.11	49.57	50.59	47.25
2020	64.40	65.39	61.97	58.21	55.61	57.27	61.45	64.76	67.54	67.79	66.04	65.58	63.00
2021	68.36	70.56	65.10	60.74	59.14	60.47	64.20	67.91	71.58	72.34	70.09	68.52	66.59
2022	69.03	70.62	66.80	62.32	59.03	60.99	65.24	69.32	73.68	74.23	72.75	70.07	67.84
2023	71.59	72.91	68.80	64.69	63.20	64.07	67.54	71.59	75.56	77.07	74.67	72.81	70.38
2024	74.61	76.34	72.51	68.27	63.80	65.16	70.44	74.95	79.19	80.03	77.21	76.49	73.25
2025	81.03	83.46	78.97	74.42	71.23	71.75	77.40	82.30	88.17	88.12	85.45	83.01	80.44
2026	87.42	90.11	87.16	82.31	76.53	79.07	85.20	90.18	97.88	97.46	95.15	91.84	88.36
2027	95.57	99.32	91.51	85.97	82.94	83.72	88.84	94.87	101.79	102.06	100.39	96.10	93.59
2028	99.64	103.19	95.01	88.67	83.22	85.59	92.61	98.67	106.02	107.29	104.91	100.25	97.09
2029	103.97	107.23	100.48	93.20	89.50	89.29	97.11	104.03	110.82	111.03	107.37	106.81	101.74
2030	109.33	113.47	104.35	97.49	90.80	92.26	102.24	109.06	116.90	117.25	113.05	112.91	106.59
2031	114.55	118.50	109.66	102.03	96.87	97.26	107.12	114.13	123.36	123.71	115.31	114.50	111.42
2032	120.73	125.57	115.91	107.20	98.76	101.93	112.08	120.96	130.45	130.70	123.29	120.93	117.37
2033	127.15	132.06	121.39	112.00	107.23	108.18	118.25	128.31	137.19	138.34	130.33	127.90	124.03
2034	135.45	140.15	128.55	118.08	109.94	113.25	125.81	135.67	145.03	147.30	138.72	135.49	131.12
2035	142.63	147.79	135.90	123.96	118.49	117.99	132.44	143.26	153.40	155.14	144.80	144.44	138.35

Monthly Flat Mid-C Prices
(Nominal $/MWh)

Base + No CO_2 Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	34.57	34.49	32.45	28.48	27.56	28.37	31.29	34.37	35.30	34.90	35.11	34.63	32.63
2017	35.36	35.18	33.41	29.03	29.67	29.47	31.85	35.25	35.89	35.75	36.33	35.80	33.58
2018	36.56	36.59	34.41	30.25	29.27	29.60	32.93	36.65	37.79	37.15	37.02	37.24	34.62
2019	37.66	37.62	35.17	31.72	31.08	30.28	33.75	37.56	39.35	38.89	38.35	38.77	35.85
2020	39.12	39.12	36.49	33.32	31.35	32.13	35.64	39.49	41.44	40.73	40.80	40.62	37.52
2021	41.57	42.00	39.02	35.72	34.43	35.57	38.92	43.05	44.49	44.01	44.37	43.78	40.58
2022	43.78	44.23	40.76	37.42	35.59	37.55	41.05	45.85	46.66	46.40	47.07	46.20	42.71
2023	46.24	46.19	42.14	38.59	38.33	39.25	42.55	47.49	47.76	48.26	49.42	48.26	44.54
2024	48.78	48.76	44.34	40.96	38.73	39.60	44.89	49.59	50.77	50.65	50.40	50.76	46.52
2025	50.08	49.66	46.31	43.05	41.37	41.77	47.07	51.91	54.60	54.24	53.51	54.34	48.99
2026	56.50	57.31	54.90	50.77	46.84	50.16	55.96	61.05	64.53	64.11	64.00	62.30	57.37
2027	61.66	62.79	55.53	51.20	49.09	51.48	56.62	62.43	65.17	64.63	65.39	63.36	59.11
2028	62.21	63.26	56.34	51.48	49.03	51.94	57.90	63.86	65.70	66.02	67.05	64.58	59.95
2029	65.37	65.60	59.85	54.89	53.25	54.50	61.07	67.69	69.99	69.80	69.17	69.02	63.35
2030	67.81	68.16	60.46	56.15	52.67	55.13	63.24	69.03	71.46	71.54	71.12	72.30	64.92
2031	69.67	69.47	62.73	57.88	55.90	57.54	65.26	71.85	74.11	73.85	74.16	74.41	67.24
2032	71.93	71.68	65.06	59.64	55.60	59.87	67.10	74.48	76.80	75.69	77.96	76.60	69.37
2033	74.33	74.38	66.98	61.24	60.23	62.66	69.18	77.44	79.32	78.45	80.90	79.07	72.01
2034	77.13	76.88	69.21	62.98	60.43	63.86	71.10	80.05	81.25	81.03	83.23	81.33	74.04
2035	79.84	80.20	72.10	65.50	64.33	65.10	73.72	82.88	84.73	83.74	84.66	85.05	76.82

Monthly Flat Mid-C Prices
(Nominal $/MWh)

Base + High CO_2 Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	34.60	34.56	32.65	28.56	27.76	28.50	31.48	34.54	35.58	34.97	35.31	34.75	32.77
2017	35.48	35.39	33.57	29.18	29.64	29.47	32.16	35.53	36.09	35.87	36.47	35.97	33.74
2018	36.69	36.80	34.54	30.29	29.36	29.61	33.12	37.02	38.11	37.53	37.28	37.58	34.83
2019	37.78	37.89	35.48	31.70	30.86	30.30	34.23	38.03	39.78	39.31	38.72	39.14	36.10
2020	55.03	56.05	53.66	49.00	45.78	47.09	50.84	54.09	58.49	58.75	56.97	55.84	53.47
2021	57.66	59.59	56.29	51.59	49.47	50.48	53.86	57.61	61.84	62.50	60.78	59.11	56.73
2022	60.94	63.03	59.36	54.82	51.18	53.04	57.46	61.57	65.94	66.43	64.59	62.79	60.10
2023	64.96	66.45	62.16	57.51	55.89	56.26	60.43	64.44	69.18	70.62	68.67	66.38	63.58
2024	68.85	70.30	65.75	60.84	56.46	57.52	63.90	67.65	72.17	73.40	71.12	70.07	66.50
2025	72.28	74.68	70.12	64.76	62.02	62.67	68.45	73.42	78.73	79.39	76.67	75.63	71.57
2026	79.48	82.25	79.38	73.71	68.18	70.59	77.33	82.41	88.90	89.14	86.59	83.90	80.15
2027	85.69	88.64	81.77	75.50	72.32	73.15	79.79	85.60	91.38	91.23	89.47	86.73	83.44
2028	88.97	92.90	84.83	77.78	72.79	74.72	83.05	89.37	94.83	95.74	93.60	90.46	86.59
2029	93.14	96.71	90.47	82.39	78.96	78.80	87.64	94.27	100.12	100.28	96.94	96.29	91.33
2030	98.25	101.72	93.87	85.99	79.10	81.23	91.27	97.93	104.24	104.81	101.66	101.97	95.17
2031	102.76	105.96	98.66	89.61	85.51	86.03	95.33	102.52	109.23	109.05	106.13	105.90	99.72
2032	107.46	111.28	103.90	93.68	86.01	89.54	99.54	108.19	115.58	114.96	112.59	110.50	104.44
2033	112.66	116.81	108.49	97.52	94.16	95.14	105.45	114.70	122.01	122.12	118.83	115.68	110.30
2034	117.90	121.81	113.21	101.26	94.94	98.44	109.84	120.33	127.83	129.09	124.86	121.54	115.09
2035	123.34	129.28	119.04	106.26	102.35	102.94	115.27	126.95	135.86	135.65	130.42	128.12	121.29

Monthly Flat Mid-C Prices
(Nominal $/MWh)

Base + Low Gas Price Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	34.79	35.39	32.66	30.60	28.79	29.52	31.91	34.54	36.80	36.99	36.21	34.96	33.60
2017	37.06	37.46	35.90	33.61	32.98	33.26	35.63	37.88	39.55	39.93	39.28	38.31	36.74
2018	37.56	38.75	37.18	34.23	32.57	32.91	36.25	38.86	40.42	40.81	40.32	39.92	37.48
2019	38.82	39.99	37.89	35.11	33.90	33.86	36.95	39.53	41.55	41.99	40.73	40.19	38.38
2020	42.09	43.11	40.59	37.45	34.63	35.89	39.29	41.86	44.39	44.36	43.56	42.77	40.83
2021	44.76	46.78	42.73	39.11	37.51	38.02	40.95	44.10	47.55	48.21	47.02	45.39	43.51
2022	46.44	48.44	44.84	40.77	38.03	39.66	43.27	47.20	50.46	51.09	50.02	48.82	45.75
2023	46.23	47.81	44.67	40.52	39.17	39.51	42.67	45.95	49.18	50.54	49.00	46.67	45.16
2024	49.08	50.99	47.71	43.37	39.69	41.50	46.42	50.25	54.06	54.78	52.96	51.07	48.49
2025	52.95	55.42	51.24	46.79	44.75	45.16	49.20	53.40	57.80	58.13	56.55	55.23	52.22
2026	54.23	56.66	54.30	49.93	45.77	47.53	51.85	55.23	61.24	61.82	59.62	57.37	54.63
2027	58.45	60.85	56.02	51.62	49.53	49.69	53.61	57.28	62.71	62.94	61.03	58.71	56.87
2028	60.28	62.85	58.12	53.83	49.70	51.48	55.92	59.78	64.88	66.32	63.73	60.77	58.97
2029	63.85	66.85	62.78	57.38	55.36	55.19	59.46	64.11	69.35	69.73	66.93	65.64	63.06
2030	65.30	67.40	63.17	58.55	53.91	55.70	60.98	64.96	70.24	70.69	67.65	67.66	63.85
2031	67.73	69.70	65.44	60.54	57.71	58.40	63.21	66.74	72.46	73.24	69.01	67.41	65.97
2032	70.96	73.03	68.60	63.52	58.36	60.55	65.36	70.14	76.21	77.15	73.10	70.57	68.96
2033	74.49	76.29	71.71	65.94	63.29	63.92	68.86	73.65	80.38	81.25	76.82	74.17	72.56
2034	78.43	80.19	74.92	68.67	63.84	66.03	72.20	77.07	84.43	85.02	80.90	78.11	75.82
2035	81.73	84.14	78.76	71.73	68.39	68.08	74.85	80.86	87.02	87.84	83.64	82.37	79.12

Monthly Flat Mid-C Prices
(Nominal $/MWh)

Base + High Gas Price Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	39.06	39.61	36.76	34.77	33.36	34.18	36.56	39.06	40.97	41.43	40.80	39.79	38.03
2017	41.38	41.57	39.80	37.47	37.80	37.94	40.33	42.79	44.25	44.63	44.15	43.12	41.27
2018	44.25	45.19	43.36	40.19	38.98	39.70	43.26	46.62	48.12	48.46	47.77	47.56	44.46
2019	50.35	51.33	48.33	45.09	44.92	44.77	48.23	51.99	53.95	53.78	52.71	52.84	49.86
2020	54.35	55.48	51.32	47.90	45.66	47.12	50.95	54.95	58.02	57.49	56.69	55.82	52.98
2021	58.43	60.82	54.61	50.48	49.08	49.96	53.37	57.75	61.29	61.90	60.54	58.92	56.43
2022	58.01	59.17	55.03	50.28	47.49	49.58	53.21	57.86	61.35	61.72	62.15	59.37	56.27
2023	60.11	61.17	56.54	51.63	50.35	51.17	54.36	58.75	62.63	63.52	63.77	61.75	57.98
2024	62.69	64.01	59.43	54.61	50.74	52.23	57.41	61.57	65.94	66.72	65.63	64.56	60.46
2025	66.67	68.69	64.64	59.62	57.20	57.98	62.20	67.23	73.22	72.98	71.95	69.70	66.01
2026	72.71	75.11	71.93	66.21	61.04	64.03	69.56	75.13	81.39	81.34	80.88	78.06	73.12
2027	79.33	83.37	74.72	68.56	65.27	66.97	71.78	77.83	83.74	83.86	83.96	80.58	76.66
2028	80.82	83.68	75.76	69.14	64.59	66.99	72.95	79.74	84.08	85.32	85.64	82.25	77.58
2029	84.27	86.04	80.26	72.85	69.38	69.71	76.16	83.01	88.73	88.66	87.63	86.87	81.13
2030	86.09	89.20	81.14	74.17	68.03	70.94	78.85	84.65	90.75	90.51	89.99	89.27	82.80
2031	88.10	90.31	83.00	75.61	72.32	73.96	80.49	86.80	92.52	91.82	86.96	87.38	84.11
2032	91.73	94.21	87.17	78.90	72.88	76.75	84.36	91.04	96.54	96.30	91.48	91.28	87.72
2033	94.94	97.41	90.15	81.61	77.98	80.37	87.60	94.56	99.87	99.82	94.68	94.09	91.09
2034	99.24	101.47	94.38	85.04	79.41	83.32	91.63	99.02	104.44	104.43	98.92	98.03	94.94
2035	103.18	106.01	98.07	88.90	84.90	86.52	95.47	103.04	108.48	107.47	102.37	102.86	98.94

Monthly Flat Mid-C Prices
(Nominal $/MWh)

Base + Very High Gas Price Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	45.70	46.33	41.95	39.50	38.74	39.61	42.24	45.02	47.00	47.61	47.00	45.37	43.84
2017	46.33	46.95	44.19	41.31	42.25	42.59	45.07	48.19	49.90	50.56	50.23	48.89	46.37
2018	47.40	48.87	46.57	42.90	41.96	42.58	46.40	50.46	52.25	52.80	52.11	51.49	47.98
2019	51.56	52.71	49.44	46.32	45.95	45.44	49.39	53.38	55.82	55.63	54.61	54.21	51.21
2020	55.41	56.28	52.73	48.92	46.25	47.86	52.11	56.22	59.38	58.57	58.07	57.01	54.07
2021	61.38	63.09	57.12	52.62	50.97	52.38	56.11	61.03	63.82	64.00	63.06	61.46	58.92
2022	64.77	64.82	60.72	55.57	52.58	55.46	59.39	65.18	67.34	66.99	68.36	65.63	62.23
2023	66.91	67.96	64.08	58.84	58.82	59.77	63.75	69.53	71.79	72.67	73.30	72.12	66.63
2024	74.07	75.36	69.61	63.92	60.57	60.00	66.72	72.94	74.79	74.22	74.30	76.08	70.21
2025	75.73	76.72	70.89	65.65	64.38	64.93	71.17	77.91	81.66	80.41	79.44	78.72	73.97
2026	77.66	80.01	76.35	69.70	64.43	68.12	74.69	80.32	85.90	85.61	83.43	82.14	77.36
2027	85.90	87.50	79.61	72.78	69.45	72.62	78.37	85.21	90.65	90.42	88.86	86.57	82.33
2028	91.49	91.11	82.99	75.00	71.90	76.12	82.93	91.40	94.51	96.10	96.59	93.28	86.95
2029	95.13	95.93	89.53	80.79	78.69	80.34	88.63	97.45	102.07	102.44	100.10	98.67	92.48
2030	97.29	100.22	94.30	86.20	80.61	83.94	93.79	102.16	108.30	107.61	105.59	103.22	96.94
2031	103.94	104.64	98.28	89.18	86.43	88.93	98.15	105.76	112.61	112.56	108.31	108.11	101.41
2032	109.89	110.95	104.58	94.82	88.27	94.48	104.26	113.18	119.83	119.98	116.67	114.75	107.64
2033	116.81	117.15	110.08	98.89	96.61	100.70	110.18	119.58	125.87	126.56	123.36	120.79	113.88
2034	123.72	123.57	116.22	103.44	99.98	105.87	116.91	126.23	133.31	134.14	130.49	127.33	120.10
2035	130.42	131.51	123.50	110.38	106.96	110.77	123.36	133.36	141.26	140.71	135.84	135.46	126.96

Monthly Flat Mid-C Prices
(Nominal $/MWh)

Base + Low Demand Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	37.33	38.04	36.51	32.77	30.75	32.00	34.78	37.00	38.80	38.95	38.95	37.45	36.11
2017	38.54	39.27	37.81	33.73	33.05	33.41	35.78	38.19	39.95	40.28	40.33	38.99	37.44
2018	39.86	40.75	39.11	35.04	32.52	33.58	37.15	39.53	41.71	41.66	41.48	40.73	38.59
2019	41.48	42.50	40.77	36.22	34.47	34.73	38.54	41.04	43.81	43.75	43.31	42.57	40.27
2020	43.32	44.05	42.61	38.04	34.45	36.27	40.05	42.91	45.81	45.74	45.58	44.59	41.95
2021	45.47	47.00	44.64	40.59	38.14	39.23	42.65	45.97	48.58	48.45	48.54	47.26	44.71
2022	47.67	49.18	46.52	42.24	38.84	40.54	44.72	48.48	50.77	50.80	50.94	49.63	46.69
2023	50.31	51.53	48.15	43.43	42.06	42.69	46.36	50.06	52.27	52.93	53.06	51.85	48.72
2024	52.68	54.06	50.37	45.76	41.88	42.75	48.40	52.10	54.78	55.16	54.80	53.96	50.56
2025	54.60	55.82	52.47	47.53	45.36	45.98	50.55	54.45	58.42	58.44	58.13	57.74	53.29
2026	59.88	62.49	59.51	54.21	48.91	52.00	58.00	62.15	67.33	67.14	66.78	64.60	60.25
2027	64.40	67.00	60.58	54.84	51.87	53.38	58.93	63.38	68.17	67.96	67.89	65.48	61.99
2028	65.51	68.23	62.21	55.68	51.50	53.99	60.20	64.59	69.27	69.93	69.89	67.10	63.18
2029	68.52	70.63	65.90	58.37	56.02	55.75	62.97	68.24	72.71	72.97	72.07	70.78	66.24
2030	71.04	73.51	66.81	59.99	54.82	56.73	65.01	69.53	74.78	74.71	74.45	73.71	67.92
2031	74.40	76.22	70.00	63.34	60.58	61.11	67.91	73.46	78.51	77.63	78.16	77.23	71.54
2032	77.09	79.12	72.66	64.94	58.81	63.03	71.18	77.03	81.24	80.87	81.74	80.34	74.00
2033	80.27	82.37	76.07	67.94	65.63	65.95	74.03	80.34	84.35	84.07	85.11	83.26	77.45
2034	84.28	86.04	79.24	71.31	66.34	69.18	77.73	83.98	87.85	88.02	88.81	86.54	80.78
2035	87.28	89.79	82.77	74.54	71.87	72.10	80.83	87.67	91.96	90.91	91.23	90.07	84.25

Monthly Flat Mid-C Prices
(Nominal $/MWh)

Base + High Demand Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	Ave
2016	39.94	40.63	39.07	34.82	33.42	34.34	36.50	38.91	40.75	41.27	41.36	39.90	38.41
2017	41.48	41.94	40.63	36.28	35.66	36.02	37.71	40.14	42.03	42.76	42.83	41.64	39.93
2018	42.78	43.51	41.80	37.89	35.70	36.21	38.90	41.48	44.02	44.04	43.99	43.63	41.16
2019	44.74	45.31	43.54	39.59	37.76	37.79	40.70	43.40	46.43	46.80	46.07	45.92	43.17
2020	46.43	47.18	45.63	41.69	38.89	39.98	42.82	45.47	48.78	48.95	48.72	47.95	45.21
2021	49.07	50.84	48.21	44.44	42.34	43.19	45.61	48.74	52.74	53.16	52.95	51.04	48.53
2022	51.64	53.66	50.43	46.70	43.62	44.93	48.18	51.72	55.68	56.50	56.08	53.76	51.08
2023	54.57	56.17	52.22	48.31	46.96	47.06	50.24	53.84	57.50	58.80	58.26	55.88	53.32
2024	57.31	58.95	55.01	51.01	47.03	47.76	52.57	56.08	60.11	60.95	59.60	58.39	55.40
2025	59.43	61.54	57.74	53.39	50.84	51.28	55.39	59.06	64.50	64.88	63.80	62.63	58.71
2026	66.61	70.11	66.98	61.86	56.58	59.14	63.84	68.17	75.12	75.83	75.12	71.88	67.60
2027	72.39	75.88	68.37	63.10	59.69	60.98	65.07	69.63	76.43	77.23	77.06	73.07	69.91
2028	73.95	78.06	70.22	64.41	59.76	61.96	67.38	71.89	78.71	80.66	79.77	75.39	71.85
2029	76.56	80.04	74.21	67.57	64.13	64.61	70.23	75.17	81.33	82.19	81.23	79.85	74.76
2030	79.65	83.47	75.62	69.71	64.06	66.06	72.86	77.30	84.30	85.18	83.91	83.75	77.16
2031	82.24	85.95	78.88	72.75	69.67	70.24	75.70	80.20	88.14	88.74	87.85	85.69	80.50
2032	84.48	87.85	81.61	75.07	69.97	72.49	77.72	82.87	90.53	91.28	91.32	87.55	82.73
2033	87.86	91.13	84.21	78.24	75.74	76.26	80.91	86.61	93.98	95.14	94.44	90.40	86.24
2034	91.12	94.12	87.37	81.35	77.52	79.07	84.53	89.65	97.12	99.41	97.64	93.86	89.40
2035	94.31	98.05	91.18	84.63	82.08	81.35	87.40	92.88	99.19	100.96	99.58	97.87	92.46

Electric Integrated Portfolio Results–2013 Planning Standard

This table summarizes the expected costs of the different portfolios.

Figure N-30: Revenue Requirements for Optimal Portfolio with Expected Inputs for the Scenarios

Expected Cost for All Portfolios, 2013 Planning Standard

Scenario	NPV to 2016 ($Millions)						
	Expected Portfolio Cost	Net Market Purchases/ (Sales)	DSR Rev. Req.	Generic Rev. Req.	Generic End Effects	Variable Cost of Existing	REC Revenue
Base	$12,277	$4,267	$990	$1,235	$838	$4,956	($11)
Low	$7,200	$1,561	$942	$565	$388	$3,756	($12)
High	$17,591	$2,088	$993	$8,104	$620	$5,885	($98)
Base + Low Gas	$11,568	$2,528	$990	$2,296	$796	$4,967	($11)
Base + High Gas	$12,899	$4,713	$990	$1,235	$808	$5,163	($11)
Base + Very High Gas	$13,656	$5,444	$1,210	$1,296	$641	$5,091	($24)
Base + No CO2	$9,924	$1,056	$990	$2,286	$729	$4,873	($11)
Base + High CO2	$13,501	$3,961	$1,170	$3,467	$483	$4,444	($24)
Base + Low Demand	$9,757	$3,908	$942	$596	$328	$4,000	($16)
Base + High Demand	$15,548	$3,295	$1,337	$3,840	$1,350	$5,744	($22)

Figure N-31: Revenue Requirements for Optimal Portfolio with Expected Inputs for the Sensitivities

Expected Cost for All Portfolios, 2013 Planning Standard

Scenario	NPV to 2016 ($Millions)						
	Expected Portfolio Cost	Net Market Purchases / (Sales)	DSR Rev. Req.	Generic Rev. Req.	Generic End Effects	Variable Cost of Existing	REC Revenue
No DSR	$14,208	$5,474	$0	$3,791	$1,400	$4,956	($16)
All CCCT	$12,471	$2,818	$1,210	$3,499	$776	$4,956	($13)
Mix CCCT & Frame	$12,363	$3,368	$990	$3,059	$815	$4,956	($11)
East Side Plant	$12,171	$2,459	$1,210	$3,558	$626	$4,956	($13)
Battery 2023	$12,374	$4,185	$1,170	$2,076	$877	$4,956	($14)
Battery 2023 flex	$12,277	$4,185	$1,170	$1,980	$852	$4,956	($14)
80MW PS	$12,478	$4,267	$990	$2,274	$1,009	$4,956	($11)
200MW PS	$12,915	$4,376	$691	$2,907	$1,392	$4,956	($18)
75MW Recip	$12,263	$4,267	$993	$2,057	$822	$4,956	($11)
75MW Recip 2023	$12,282	$4,242	$993	$2,106	$802	$4,956	($16)
224MW Recip 2023	$12,354	$4,267	$993	$2,148	$853	$4,956	($11)
MT 40%	$12,503	$3,936	$990	$2,630	$884	$4,956	($11)
MT 45%	$12,483	$3,927	$967	$2,644	$883	$4,956	($12)
MT 50%	$12,474	$3,936	$927	$2,663	$881	$4,956	($11)
MT 55%	$12,462	$3,927	$929	$2,660	$882	$4,956	($12)
Max PV	$12,211	$4,203	$990	$2,073	$838	$4,956	($12)
Wind Carbon*	$12,654	$3,920	$990	$2,798	$923	$4,956	($11)
Wind Re-Opt*	$12,624	$3,920	$990	$2,768	$926	$4,956	($11)
Solar Carbon*	$12,875	$4,057	$990	$2,881	$1,017	$4,956	($11)
DSR E Carbon*	$12,340	$4,202	$1,146	$2,046	$841	$4,956	($11)
DSR F Carbon*	$12,336	$4,183	$1,146	$2,060	$839	$4,956	($11)
DSR G Carbon*	$12,345	$4,090	$1,439	$1,875	$765	$4,956	($15)

**Results shown are for the total portfolio NPV. Chapter 6 sensitivity is just the 25-yr NPV.*

Figure N-32: Annual Revenue Requirements for Optimal Portfolio ($Millions)
2013 Planning Standard

	Base	Low	High	Base + Low Gas	Base + High Gas	Base + Very High Gas	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
2016	720	526	659	679	722	789	606	617	667	794
2017	767	572	816	743	784	844	645	660	705	894
2018	812	599	876	784	843	892	680	696	744	975
2019	802	580	900	767	855	888	668	686	727	952
2020	856	620	1,269	826	919	951	709	1,000	775	1,051
2021	855	601	1,356	824	922	963	694	1,006	767	1,028
2022	910	641	1,470	881	964	1,031	737	1,074	813	1,146
2023	996	609	1,568	936	1,045	1,090	809	1,158	809	1,256
2024	1,063	641	1,617	1,020	1,112	1,188	862	1,298	903	1,288
2025	1,084	695	1,723	1,046	1,156	1,225	868	1,353	908	1,377
2026	1,228	648	1,953	1,106	1,312	1,349	968	1,545	964	1,532
2027	1,302	658	2,055	1,280	1,403	1,447	1,121	1,627	1,000	1,598
2028	1,414	677	2,264	1,331	1,515	1,570	1,152	1,702	1,037	1,777
2029	1,530	793	2,515	1,444	1,639	1,777	1,224	1,854	1,190	1,903
2030	1,597	799	2,633	1,477	1,705	1,875	1,260	2,046	1,238	1,990
2031	1,765	850	2,858	1,564	1,858	2,025	1,332	2,182	1,330	2,242
2032	1,830	859	3,031	1,627	1,944	2,195	1,360	2,298	1,365	2,373
2033	1,931	880	3,322	1,779	2,049	2,375	1,477	2,413	1,418	2,608
2034	2,016	897	3,522	1,850	2,147	2,498	1,521	2,520	1,463	2,726
2035	2,130	907	3,757	1,927	2,276	2,629	1,554	2,643	1,506	2,862
20-yr NPV	11,439	6,812	16,971	10,771	12,091	13,015	9,195	13,018	9,429	14,198
End Effects	838	388	620	796	808	641	729	483	328	1,350
Expected Cost	12,277	7,200	17,591	11,568	12,899	13,656	9,924	13,501	9,757	15,548

Figure N-33: Annual Revenue Requirements for Sensitivities ($Millions)
2013 Planning Standard

	No DSR	All CCCT	Mix CCCT & Frame	Gas Plant Location	Battery 2023	Battery 2023 flexibility	80MW PS	200MW PS	75MW Recip	75MW Recip 2023	224MW Recip 2023
2016	653	732	720	732	730	730	720	707	721	721	721
2017	702	784	767	784	781	781	767	748	767	767	767
2018	772	831	812	831	827	827	812	788	812	812	812
2019	775	824	802	824	819	819	802	777	803	803	803
2020	819	880	856	880	874	874	856	821	856	856	856
2021	911	881	855	881	874	874	855	829	856	856	856
2022	987	937	910	937	929	929	910	872	911	911	911
2023	1,145	989	996	989	983	969	976	1,026	996	970	1,010
2024	1,196	1,129	1,063	1,113	1,048	1,034	1,043	1,066	1,063	1,062	1,076
2025	1,292	1,148	1,084	1,133	1,119	1,105	1,116	1,165	1,084	1,132	1,097
2026	1,549	1,271	1,228	1,243	1,218	1,204	1,258	1,270	1,228	1,270	1,240
2027	1,608	1,333	1,410	1,304	1,332	1,317	1,332	1,372	1,302	1,318	1,314
2028	1,730	1,412	1,464	1,382	1,385	1,371	1,389	1,432	1,414	1,376	1,426
2029	1,865	1,521	1,577	1,489	1,497	1,482	1,560	1,552	1,530	1,549	1,542
2030	2,028	1,694	1,641	1,644	1,617	1,602	1,627	1,680	1,597	1,617	1,609
2031	2,114	1,801	1,749	1,752	1,730	1,715	1,736	1,782	1,765	1,728	1,776
2032	2,202	1,859	1,814	1,810	1,791	1,776	1,802	1,857	1,830	1,853	1,841
2033	2,366	1,950	1,971	1,899	1,948	1,933	1,963	2,006	1,931	1,954	1,942
2034	2,475	2,026	2,053	1,975	2,029	2,014	2,047	2,098	2,016	2,038	2,026
2035	2,615	2,105	2,137	2,053	2,110	2,095	2,132	2,192	2,131	2,124	2,140
20-yr NPV	12,808	11,695	11,548	11,545	11,497	11,425	11,469	11,523	11,441	11,480	11,501
End Effects	1,400	776	815	626	877	852	1,009	1,392	822	802	853
Expected Cost	14,208	12,471	12,363	12,171	12,374	12,277	12,478	12,915	12,263	12,282	12,354

Annual Revenue Requirements for Sensitivities ($Millions)
2013 Planning Standard

	MT 40%	MT 45%	MT 50%	MT 55%	Max PV	Wind Carbon	Solar Carbon	Wind Re-Opt	DSR E Carbon	DSR F Carbon	DSR G Carbon
2016	720	720	719	719	720	720	720	720	730	731	761
2017	767	767	764	765	767	767	767	767	780	781	814
2018	812	809	808	808	811	812	812	812	825	827	860
2019	802	801	796	797	801	802	802	802	817	818	853
2020	856	845	850	850	854	856	856	856	863	874	908
2021	855	853	850	851	853	939	960	939	872	875	909
2022	910	897	905	906	908	985	1,005	984	916	932	964
2023	1,052	1,051	1,045	1,045	992	1,061	1,081	1,061	1,010	1,007	988
2024	1,108	1,108	1,101	1,101	1,058	1,121	1,140	1,121	1,076	1,073	1,053
2025	1,170	1,169	1,163	1,163	1,078	1,136	1,155	1,136	1,095	1,092	1,124
2026	1,247	1,270	1,292	1,263	1,220	1,269	1,290	1,269	1,225	1,215	1,186
2027	1,369	1,364	1,359	1,357	1,293	1,340	1,361	1,340	1,288	1,278	1,300
2028	1,421	1,417	1,411	1,409	1,404	1,450	1,470	1,396	1,425	1,414	1,354
2029	1,532	1,529	1,577	1,577	1,517	1,562	1,583	1,564	1,536	1,525	1,465
2030	1,654	1,651	1,641	1,641	1,583	1,627	1,647	1,629	1,598	1,586	1,586
2031	1,760	1,757	1,747	1,747	1,748	1,791	1,812	1,735	1,711	1,756	1,698
2032	1,822	1,820	1,809	1,810	1,811	1,854	1,875	1,858	1,830	1,816	1,759
2033	1,979	1,978	1,966	1,967	1,908	1,951	1,972	1,955	1,927	1,911	1,905
2034	2,059	2,058	2,046	2,046	1,989	2,032	2,054	2,035	2,008	1,991	1,997
2035	2,141	2,139	2,127	2,127	2,100	2,143	2,165	2,146	2,118	2,102	2,078
20-yr NPV	11,619	11,599	11,592	11,580	11,373	11,732	11,858	11,698	11,499	11,496	11,580
End Effects	884	883	881	882	838	923	1,017	926	841	839	765
Expected Cost	12,503	12,483	12,474	12,462	12,211	12,654	12,875	12,624	12,340	12,336	12,345

Figure N-34: Revenue Requirement with Input Simulations – 1,000 Trials
2013 Planning Standard

Expected Portfolio Cost ($Millions)	Risk Simulation - 1000 Trials			
	Base_All Frame Peaker	All CCCT	Mix CCCT & Frame	No DSR
Minimum	$7,358	$7,360	$7,291	$8,822
1st Quartile (P25)	$9,738	$9,506	$9,506	$11,363
Mean	$11,129	$10,858	$10,899	$12,932
Median (P50)	$11,123	$10,901	$10,921	$12,931
3rd Quartile (P75)	$12,385	$11,874	$12,027	$14,337
TVar90	$14,445	$13,778	$13,932	$16,480
Maximum	$16,078	$15,466	$15,643	$18,366
Base Deterministic	$12,277	$12,471	$12,363	$14,208

Figure N-35: Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Scenarios: Base, Base +High Gas Price

Sensitivity: Max PV

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	41
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	43
2021	-	-	-	-	-	-	62	2
2022	-	-	-	-	25	-	66	12
2023	-	228	100	-	-	-	56	2
2024	-	-	100	-	-	-	55	3
2025	-	-	-	-	-	-	53	2
2026	-	455	-	-	-	-	27	2
2027	-	-	100	-	-	-	27	2
2028	-	228	-	-	-	-	27	3
2029	-	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	23	2
2031	-	228	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	80	24	2
Total	-	1,138	300	15	25	80	906	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Scenarios: Low, Base + Low Demand

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	62	12
2018	-	-	-	-	-	-	66	42
2019	-	-	-	-	-	-	63	14
2020	-	-	-	-	-	-	77	44
2021	-	-	-	-	-	-	60	2
2022	-	-	-	-	-	-	64	13
2023	-	-	-	-	-	-	55	2
2024	-	-	-	-	-	-	54	3
2025	-	-	200	-	-	-	51	2
2026	-	228	-	-	-	-	26	2
2027	-	-	-	-	-	-	27	2
2028	-	-	-	-	-	-	27	3
2029	-	228	-	-	-	-	23	2
2030	-	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	26	2
2032	-	-	-	-	-	-	32	2
2033	-	-	-	-	-	-	29	2
2034	-	-	-	-	-	-	24	2
2035	-	-	-	-	-	-	24	2
Total	-	455	200	-	-	-	888	174

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Scenario: High

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	385	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	42
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	44
2021	-	-	300	-	-	-	62	2
2022	-	-	300	-	-	-	66	13
2023	385	-	-	-	-	-	56	2
2024	-	-	-	-	-	-	55	3
2025	-	-	-	-	-	-	53	2
2026	385	-	-	-	-	-	27	2
2027	-	-	-	-	-	-	27	2
2028	385	-	-	-	-	-	27	3
2029	-	-	400	-	-	-	23	2
2030	-	-	-	-	-	-	23	2
2031	385	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	385	-	-	-	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	2,312	-	1,000	-	-	-	906	174

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Scenarios: Base + Low Gas Price, Base + No CO_2
Sensitivity: Mix CCCT & Peaker

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	41
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	43
2021	-	-	-	-	-	-	62	2
2022	-	-	-	-	25	-	66	12
2023	-	228	100	-	-	-	56	2
2024	-	-	100	-	-	-	55	3
2025	-	-	-	-	-	-	53	2
2026	385	-	-	-	-	-	27	2
2027	385	-	100	-	-	-	27	2
2028	-	-	-	-	-	-	27	3
2029	-	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	228	-	15	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	771	455	300	15	25	-	906	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard
Scenario: Base + Very High Gas Price

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	77	18
2017	-	-	-	-	-	-	66	12
2018	-	-	-	-	-	-	71	41
2019	-	-	-	-	-	-	69	14
2020	-	-	-	-	-	-	84	43
2021	-	-	-	-	-	-	68	2
2022	-	-	-	-	-	-	72	12
2023	-	-	200	-	-	-	61	2
2024	-	228	-	-	-	-	59	3
2025	-	-	-	-	-	-	58	2
2026	-	455	-	-	-	-	28	2
2027	-	-	-	-	-	-	30	2
2028	-	-	100	-	-	-	29	3
2029	-	228	-	-	-	-	25	2
2030	-	-	-	-	-	-	25	2
2031	-	-	-	-	-	-	29	2
2032	-	-	300	-	-	-	35	2
2033	-	228	-	-	-	-	31	2
2034	-	-	-	-	-	-	26	2
2035	-	-	-	-	-	-	25	2
Total	-	1,138	600	-	-	-	968	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Scenario: Base + High CO_2

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	77	18
2017	-	-	-	-	-	-	66	12
2018	-	-	-	-	-	-	70	41
2019	-	-	-	-	-	-	68	14
2020	-	-	-	-	-	-	82	43
2021	-	-	-	-	-	-	66	2
2022	-	-	-	-	-	-	70	12
2023	-	-	300	-	-	-	60	2
2024	385	-	-	-	-	-	58	3
2025	-	-	-	-	-	-	56	2
2026	385	-	-	-	-	-	28	2
2027	-	-	-	-	-	-	30	2
2028	-	-	-	-	-	-	29	3
2029	-	-	-	-	-	-	25	2
2030	385	-	-	-	-	-	25	2
2031	-	-	-	-	-	-	29	2
2032	-	-	100	-	-	-	35	2
2033	-	-	-	-	-	-	31	2
2034	-	-	-	-	-	-	26	2
2035	-	-	-	-	-	-	25	2
Total	1,156	-	400	-	-	-	956	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Scenario: Base + High Demand

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	77	24
2017	-	228	-	-	25	-	66	12
2018	-	-	-	-	-	-	70	67
2019	-	-	-	-	75	-	68	14
2020	-	-	-	-	-	-	82	77
2021	-	-	-	-	100	-	66	3
2022	-	-	200	-	100	-	70	13
2023	-	228	200	-	-	-	60	3
2024	-	-	-	-	-	-	58	4
2025	-	228	-	-	-	-	56	3
2026	385	-	-	-	-	-	28	3
2027	-	-	-	-	-	-	30	3
2028	385	-	-	-	-	-	29	4
2029	-	-	-	-	-	-	25	3
2030	-	-	-	-	-	-	25	3
2031	385	-	-	-	-	-	29	3
2032	-	-	100	-	-	-	35	3
2033	385	-	-	-	-	-	31	3
2034	-	-	-	-	-	-	26	3
2035	-	-	-	-	-	-	25	3
Total	1,542	683	500	-	300	-	956	254

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + Colstrip 1 & 2 Retired*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	MT Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	-	79	35
2021	-	-	-	-	-	-	-	62	2
2022	-	-	-	-	-	50	-	66	2
2023	-	228	100	-	-	-	-	56	2
2024	-	-	100	-	-	-	-	55	2
2025	-	-	-	-	-	-	-	53	2
2026	-	683	-	-	-	-	-	27	2
2027	-	-	100	100	-	-	-	27	2
2028	-	-	-	100	-	-	-	27	2
2029	-	228	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	-	27	2
2032	-	-	-	100	-	-	-	32	2
2033	-	228	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	-	24	2
Total	0	1,366	300	300	15	50	0	906	148

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + Colstrip All 4 Units Retired*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	MT Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	-	67	41
2019	-	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	-	79	43
2021	-	-	-	-	-	-	-	62	2
2022	-	-	-	-	-	25	-	66	12
2023	-	228	100	-	-	-	-	56	2
2024	-	-	100	-	-	-	-	55	3
2025	-	-	-	-	-	-	-	53	2
2026	771	228	-	-	-	-	-	27	2
2027	-	-	100	100	-	-	-	27	2
2028	-	-	-	100	-	-	-	27	3
2029	-	228	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	-	27	2
2032	-	-	-	100	-	-	-	32	2
2033	-	228	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	-	24	2
Total	771	910	300	300	15	25	0	906	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Low + Colstrip 1&2 Retired*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	MT Wind	Biomass	Solar	Battery	DSR	DR
2016	-	-	-	-	-	-	-	73	6
2017	-	-	-	-	-	-	-	59	0
2018	-	-	-	-	-	-	-	62	26
2019	-	-	-	-	-	-	-	59	1
2020	-	-	-	-	-	-	-	72	35
2021	-	-	-	-	-	-	-	55	1
2022	-	-	-	-	-	-	-	58	1
2023	-	-	-	-	-	-	-	50	1
2024	-	-	-	-	-	-	-	49	1
2025	-	-	200	-	-	-	-	46	1
2026	-	683	-	-	-	-	-	24	1
2027	-	-	-	-	-	-	-	24	1
2028	-	-	-	-	-	-	-	25	1
2029	-	228	-	-	-	-	-	21	1
2030	-	-	-	-	-	20	-	21	1
2031	-	-	-	-	-	-	-	20	1
2032	-	-	-	-	-	-	-	26	1
2033	-	-	-	-	-	20	-	23	1
2034	-	-	-	-	-	-	-	20	1
2035	-	-	-	-	-	-	-	19	1
Total	0	910	200	0	0	40	0	808	84

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Low + Colstrip All 4 Units Retired*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	MT Wind	Biomass	Solar	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	6
2017	-	-	-	-	-	-	-	62	0
2018	-	-	-	-	-	-	-	66	28
2019	-	-	-	-	-	-	-	63	1
2020	-	-	-	-	-	-	-	77	42
2021	-	-	-	-	-	-	-	60	1
2022	-	-	-	-	-	-	-	64	11
2023	-	-	-	-	-	-	-	55	1
2024	-	-	-	-	-	-	-	54	2
2025	-	-	200	-	-	-	-	51	1
2026	-	910	-	-	-	-	-	26	1
2027	-	-	-	-	-	-	-	27	1
2028	-	-	-	-	-	-	-	27	1
2029	-	228	-	-	-	-	-	23	1
2030	-	-	-	-	-	-	-	23	1
2031	-	-	-	-	-	-	-	26	1
2032	-	-	-	-	-	-	-	32	1
2033	-	-	-	-	-	-	-	29	1
2034	-	-	-	-	-	-	-	24	1
2035	-	-	-	-	-	-	-	24	1
Total	0	1,138	200	0	0	0	0	888	108

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *High + Colstrip 1&2 Retired*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	MT Wind	Biomass	Solar	Battery	DSR	DR
2016	-	-	-	-	-	-	-	77	18
2017	385	-	-	-	-	-	-	66	12
2018	-	-	-	-	-	-	-	71	41
2019	-	-	-	-	-	-	-	69	14
2020	-	-	-	-	-	-	-	84	43
2021	-	-	-	-	-	-	-	68	2
2022	-	-	300	-	-	-	-	72	12
2023	385	-	-	-	-	-	-	61	2
2024	-	-	-	-	-	-	-	59	3
2025	-	-	-	-	-	-	-	58	2
2026	385	-	-	500	-	-	-	28	2
2027	-	-	-	-	-	-	-	30	2
2028	385	-	100	-	-	-	-	29	3
2029	-	-	100	-	-	-	-	25	2
2030	-	-	-	-	-	-	-	25	2
2031	385	-	-	-	-	-	-	29	2
2032	-	-	-	-	-	-	-	35	2
2033	385	-	-	-	-	-	-	31	2
2034	-	-	-	-	-	-	-	26	2
2035	-	-	-	-	-	-	-	25	2
Total	2,312	0	500	500	0	0	0	968	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *High + Colstrip All 4 Units Retired*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	MT Wind	Biomass	Solar	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	385	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	-	67	42
2019	-	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	-	79	44
2021	-	-	300	-	-	-	-	62	2
2022	385	-	-	-	-	-	-	66	13
2023	-	-	-	-	-	-	-	56	2
2024	-	-	-	-	-	-	-	55	3
2025	-	-	-	-	-	-	-	53	2
2026	771	-	-	500	-	-	-	27	2
2027	-	-	-	-	-	-	-	27	2
2028	385	-	100	-	-	-	-	27	3
2029	-	-	100	-	-	-	-	23	2
2030	-	-	-	-	-	-	-	23	2
2031	385	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	-	32	2
2033	385	-	-	-	-	-	-	29	2
2034	-	-	-	-	-	-	-	25	2
2035	-	-	-	-	15	-	-	24	2
Total	2,698	0	500	500	15	0	0	906	174

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + No DSR*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	33	-
2017	-	-	-	-	75	-	15	-
2018	-	228	-	-	-	-	13	-
2019	-	-	-	-	-	-	11	-
2020	-	-	-	-	50	-	27	-
2021	-	228	-	-	-	-	10	-
2022	-	-	100	-	75	-	11	-
2023	-	228	200	-	-	-	9	-
2024	-	-	-	-	-	-	9	-
2025	-	228	-	-	-	-	6	-
2026	-	455	100	-	-	-	7	-
2027	-	-	-	-	-	-	6	-
2028	-	228	-	-	-	-	8	-
2029	-	-	-	-	-	-	5	-
2030	-	228	100	-	-	-	6	-
2031	-	-	-	-	-	-	3	-
2032	-	-	-	-	-	-	5	-
2033	-	228	-	-	-	-	6	-
2034	-	-	-	-	-	-	4	-
2035	-	-	-	-	-	80	4	-
Total	-	2,048	500	-	200	80	197*	-

**197 MW reflects the no cost codes and standards bundle*

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivities: *Base + All CCCT, Base + Gas Plant Location (East side)*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	77	18
2017	-	-	-	-	-	-	66	12
2018	-	-	-	-	-	-	71	41
2019	-	-	-	-	-	-	69	14
2020	-	-	-	-	-	-	84	43
2021	-	-	-	-	-	-	68	2
2022	-	-	-	-	-	-	72	12
2023	-	-	200	-	-	-	61	2
2024	385	-	-	-	-	-	59	3
2025	-	-	-	-	-	-	58	2
2026	385	-	-	-	-	-	28	2
2027	-	-	-	-	-	-	30	2
2028	-	-	100	-	-	-	29	3
2029	-	-	-	-	-	-	25	2
2030	385	-	-	-	-	-	25	2
2031	-	-	-	-	-	-	29	2
2032	-	-	-	-	-	-	35	2
2033	-	-	-	15	-	-	31	2
2034	-	-	-	-	-	-	26	2
2035	-	-	-	-	-	-	25	2
Total	1,156	-	300	15	-	-	968	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + 80 MW Pump Storage*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Pumped Storage	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	41
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	43
2021	-	-	-	-	-	-	62	2
2022	-	-	-	-	25	-	66	12
2023	-	-	100	-	-	80	56	2
2024	-	-	100	-	-	-	55	3
2025	-	228	-	-	-	-	53	2
2026	-	455	-	-	-	-	27	2
2027	-	-	100	-	-	-	27	2
2028	-	-	-	-	-	-	27	3
2029	-	228	-	-	-	-	23	2
2030	-	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	228	-	15	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	-	1,138	300	15	25	80	906	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + 200 MW Pump Storage*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Pumped Storage	DSR	DR
2016	-	-	-	-	-	-	73	18
2017	-	-	-	-	-	-	59	12
2018	-	-	-	-	-	-	62	39
2019	-	-	-	-	-	-	59	14
2020	-	-	-	-	-	-	72	35
2021	-	-	-	-	-	-	55	2
2022	-	-	-	-	25	-	58	2
2023	-	-	200	-	75	200	50	2
2024	-	-	-	-	-	-	49	2
2025	-	228	100	-	-	-	46	2
2026	-	228	-	-	-	-	24	2
2027	-	228	-	-	-	-	24	2
2028	-	-	-	-	-	-	25	2
2029	-	-	-	-	-	-	21	2
2030	-	228	-	-	-	-	21	2
2031	-	-	100	-	-	-	20	2
2032	-	-	-	-	-	-	26	2
2033	-	228	-	-	-	-	23	2
2034	-	-	-	-	-	-	20	2
2035	-	-	-	-	-	-	19	2
Total	0	1,138	400	0	100	200	808	148

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivities: *Base + Battery 2023, Base + Battery 2023 Flexibility*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	77	18
2017	-	-	-	-	-	-	66	12
2018	-	-	-	-	-	-	70	41
2019	-	-	-	-	-	-	68	14
2020	-	-	-	-	-	-	82	43
2021	-	-	-	-	-	-	66	2
2022	-	-	-	-	-	-	70	12
2023	-	-	100	-	-	80	60	2
2024	-	-	100	-	-	-	58	3
2025	-	228	-	-	-	-	56	2
2026	-	228	100	-	-	-	28	2
2027	-	228	-	-	-	-	30	2
2028	-	-	-	-	-	-	29	3
2029	-	-	-	-	-	-	25	2
2030	-	228	-	-	-	-	25	2
2031	-	-	-	-	-	-	29	2
2032	-	-	-	-	-	-	35	2
2033	-	228	-	15	-	-	31	2
2034	-	-	-	-	-	-	26	2
2035	-	-	-	-	-	-	25	2
Total	-	1,138	300	15	-	80	956	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + 75 MW Recip*

Annual Builds (MW)	CCCT	Frame Peaker	Recip Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	-	67	42
2019	-	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	-	79	44
2021	-	-	-	-	-	-	-	62	2
2022	-	-	-	-	-	25	-	66	13
2023	-	228	-	100	-	-	-	56	2
2024	-	-	-	100	-	-	-	55	3
2025	-	-	-	-	-	-	-	53	2
2026	-	455	-	-	-	-	-	27	2
2027	-	-	-	100	-	-	-	27	2
2028	-	228	-	-	-	-	-	27	3
2029	-	-	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	-	23	2
2031	-	228	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	-	32	2
2033	-	-	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	-	25	2
2035	-	-	75	-	-	-	-	24	2
Total	0	1,138	75	300	15	25	0	906	174

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + 75 MW Recip 2023*

Annual Builds (MW)	CCCT	Frame Peaker	Recip Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	-	67	42
2019	-	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	-	79	44
2021	-	-	-	-	-	-	-	62	2
2022	-	-	-	-	-	25	-	66	13
2023	-	-	75	100	-	-	-	56	2
2024	-	-	-	200	-	-	-	55	3
2025	-	228	-	-	-	-	-	53	2
2026	-	455	-	-	-	-	-	27	2
2027	-	-	-	-	-	-	-	27	2
2028	-	-	-	-	-	-	-	27	3
2029	-	228	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	-	27	2
2032	-	228	-	-	-	-	-	32	2
2033	-	-	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	-	24	2
Total	0	1138	75	300	15	25	0	906	174

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + 224 MW Recip 2023*

Annual Builds (MW)	CCCT	Frame Peaker	Recip Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	-	67	42
2019	-	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	-	79	44
2021	-	-	-	-	-	-	-	62	2
2022	-	-	-	-	-	25	-	66	13
2023	-	-	224	100	-	-	-	56	2
2024	-	-	-	100	-	-	-	55	3
2025	-	-	-	-	-	-	-	53	2
2026	-	455	-	-	-	-	-	27	2
2027	-	-	-	100	-	-	-	27	2
2028	-	228	-	-	-	-	-	27	3
2029	-	-	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	-	23	2
2031	-	228	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	-	32	2
2033	-	-	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	80	24	2
Total	0	910	224	300	15	25	80	906	174

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + MT Wind 40%*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	MT Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	-	67	41
2019	-	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	-	79	43
2021	-	-	-	-	-	-	-	62	2
2022	-	-	-	-	-	25	-	66	12
2023	-	-	100	300	-	-	-	56	2
2024	-	-	100	-	-	-	-	55	3
2025	-	228	-	-	-	-	-	53	2
2026	-	228	-	-	-	-	-	27	2
2027	-	228	100	-	-	-	-	27	2
2028	-	-	-	-	-	-	-	27	3
2029	-	-	-	-	-	-	-	23	2
2030	-	228	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	-	32	2
2033	-	228	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	-	24	2
Total	0	1,138	300	300	15	25	0	906	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + MT Wind 45%*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	WT Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	-	79	35
2021	-	-	-	-	-	-	-	62	2
2022	-	-	-	-	-	50	-	66	2
2023	-	-	100	300	-	-	-	56	2
2024	-	-	100	-	-	-	-	55	2
2025	-	228	-	-	-	-	-	53	2
2026	-	228	100	-	-	-	-	27	2
2027	-	228	-	-	-	-	-	27	2
2028	-	-	-	-	-	-	-	27	2
2029	-	-	-	-	-	-	-	23	2
2030	-	228	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	-	32	2
2033	-	228	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	-	24	2
Total	0	1,138	300	300	15	50	0	906	148

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + MT Wind 50%*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	WT Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	6
2017	-	-	-	-	-	-	-	64	0
2018	-	-	-	-	-	-	-	67	28
2019	-	-	-	-	-	-	-	64	1
2020	-	-	-	-	-	-	-	79	42
2021	-	-	-	-	-	50	-	62	1
2022	-	-	-	-	-	75	-	66	11
2023	-	-	100	300	-	-	-	56	1
2024	-	-	100	-	-	-	-	55	2
2025	-	228	-	-	-	-	-	53	1
2026	-	455	-	-	-	-	-	27	1
2027	-	-	100	-	-	-	-	27	1
2028	-	-	-	-	-	-	-	27	1
2029	-	228	-	-	-	-	-	23	1
2030	-	-	-	-	-	-	-	23	1
2031	-	-	-	-	-	-	-	27	1
2032	-	-	-	-	-	-	-	32	1
2033	-	228	-	-	15	-	-	29	1
2034	-	-	-	-	-	-	-	25	1
2035	-	-	-	-	-	-	-	24	1
Total	0	1,138	300	300	15	125	0	906	108

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + MT Wind 55%*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	WT Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	6
2017	-	-	-	-	-	-	-	64	0
2018	-	-	-	-	-	-	-	67	29
2019	-	-	-	-	-	-	-	64	1
2020	-	-	-	-	-	-	-	79	43
2021	-	-	-	-	-	50	-	62	1
2022	-	-	-	-	-	75	-	66	12
2023	-	-	100	300	-	-	-	56	1
2024	-	-	100	-	-	-	-	55	2
2025	-	228	-	-	-	-	-	53	1
2026	-	228	100	-	-	-	-	27	1
2027	-	228	-	-	-	-	-	27	1
2028	-	-	-	-	-	-	-	27	1
2029	-	228	-	-	-	-	-	23	1
2030	-	-	-	-	-	-	-	23	1
2031	-	-	-	-	-	-	-	27	1
2032	-	-	-	-	-	-	-	32	1
2033	-	228	-	-	15	-	-	29	1
2034	-	-	-	-	-	-	-	25	1
2035	-	-	-	-	-	-	-	24	1
Total	0	1,138	300	300	15	125	0	906	110

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + Wind Carbon*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	41
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	43
2021	-	-	300	-	-	-	62	2
2022	-	-	-	-	25	-	66	12
2023	-	228	100	-	-	-	56	2
2024	-	-	100	-	-	-	55	3
2025	-	-	-	-	-	-	53	2
2026	-	455	-	-	-	-	27	2
2027	-	-	100	-	-	-	27	2
2028	-	228	-	-	-	-	27	3
2029	-	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	23	2
2031	-	228	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	80	24	2
Total	-	1,138	600	15	25	80	906	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + Wind Carbon (re-optimized)*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	41
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	43
2021	-	-	300	-	-	-	62	2
2022	-	-	-	-	-	-	66	12
2023	-	228	100	-	-	-	56	2
2024	-	-	100	-	-	-	55	3
2025	-	-	-	-	-	-	53	2
2026	-	455	-	-	-	-	27	2
2027	-	-	100	-	-	-	27	2
2028	-	-	-	-	-	-	27	3
2029	-	228	-	-	-	-	23	2
2030	-	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	228	-	-	-	-	32	2
2033	-	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	80	24	2
Total	-	1,138	600	15	-	80	906	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + Solar Carbon*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	Solar	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	-	67	41
2019	-	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	-	79	43
2021	-	-	-	-	300	-	-	62	2
2022	-	-	-	-	-	25	-	66	12
2023	-	228	100	-	-	-	-	56	2
2024	-	-	100	-	-	-	-	55	3
2025	-	-	-	-	-	-	-	53	2
2026	-	455	-	-	-	-	-	27	2
2027	-	-	100	-	-	-	-	27	2
2028	-	228	-	-	-	-	-	27	3
2029	-	-	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	-	23	2
2031	-	228	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	-	32	2
2033	-	-	-	15	-	-	-	29	2
2034	-	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	80	24	2
Total	-	1,138	300	15	300	25	80	906	172

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + DSR E Carbon*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	77	18
2017	-	-	-	-	-	-	66	12
2018	-	-	-	-	-	-	70	39
2019	-	-	-	-	-	-	68	14
2020	-	-	-	-	-	-	82	35
2021	-	-	-	-	-	-	66	2
2022	-	-	-	-	25	-	70	2
2023	-	228	100	-	-	-	60	2
2024	-	-	100	-	-	-	58	2
2025	-	-	-	-	-	-	56	2
2026	-	455	-	-	-	-	28	2
2027	-	-	-	-	-	-	30	2
2028	-	228	100	-	-	-	29	2
2029	-	-	-	-	-	-	25	2
2030	-	-	-	-	-	-	25	2
2031	-	-	-	-	-	-	29	2
2032	-	228	-	-	-	-	35	2
2033	-	-	-	15	-	-	31	2
2034	-	-	-	-	-	-	26	2
2035	-	-	-	-	-	80	25	2
Total	-	1,138	300	15	25	80	956	148

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + DSR F Carbon*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	77	6
2017	-	-	-	-	-	-	66	0
2018	-	-	-	-	-	-	71	28
2019	-	-	-	-	-	-	69	1
2020	-	-	-	-	-	-	84	42
2021	-	-	-	-	25	-	68	1
2022	-	-	-	-	50	-	72	11
2023	-	228	100	-	-	-	61	1
2024	-	-	100	-	-	-	59	2
2025	-	-	-	-	-	-	58	1
2026	-	455	-	-	-	-	28	1
2027	-	-	-	-	-	-	30	1
2028	-	228	100	-	-	-	29	1
2029	-	-	-	-	-	-	25	1
2030	-	-	-	-	-	-	25	1
2031	-	228	-	-	-	-	29	1
2032	-	-	-	-	-	-	35	1
2033	-	-	-	15	-	-	31	1
2034	-	-	-	-	-	-	26	1
2035	-	-	-	-	-	80	25	1
Total	-	1,138	300	15	75	80	968	108

Incremental Portfolio Builds by Year (nameplate MW), 2013 Planning Standard

Sensitivity: *Base + DSR G Carbon*

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	82	18
2017	-	-	-	-	-	-	72	12
2018	-	-	-	-	-	-	76	42
2019	-	-	-	-	-	-	74	14
2020	-	-	-	-	-	-	90	44
2021	-	-	-	-	-	-	74	2
2022	-	-	-	-	-	-	78	13
2023	-	-	100	-	-	-	66	2
2024	-	-	100	-	-	-	64	3
2025	-	228	-	-	-	-	63	2
2026	-	228	100	-	-	-	28	2
2027	-	228	-	-	-	-	31	2
2028	-	-	-	-	-	-	29	3
2029	-	-	-	-	-	-	25	2
2030	-	228	-	-	-	-	25	2
2031	-	-	-	-	-	-	29	2
2032	-	-	-	-	-	-	36	2
2033	-	228	-	-	-	-	31	2
2034	-	-	-	15	-	-	26	2
2035	-	-	-	-	-	-	25	2
Total	-	1,138	300	15	-	-	1,023	174

Figure N-35: Total Portfolio CO_2 Emissions, 2013 Planning Standard Emission PSE Portfolio - All (Millions Tons)

	Low	Base	High	Base + Low Gas Price	Base + High Gas Price	Base + Very High Gas Price	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
2016	10.89	10.14	12.34	9.08	10.36	11.24	11.69	11.60	9.32	11.10
2017	11.57	10.12	12.89	9.42	11.11	11.78	12.24	12.13	9.18	11.25
2018	11.53	10.18	12.96	9.23	11.38	11.75	12.28	12.14	9.11	11.28
2019	11.25	9.93	12.89	8.61	11.63	11.69	12.13	11.95	8.68	10.98
2020	11.42	9.97	10.64	9.00	11.77	11.79	12.29	6.26	8.62	11.11
2021	11.37	10.09	10.16	9.19	11.72	11.81	12.35	6.02	8.80	11.32
2022	11.18	10.01	8.48	9.08	11.32	11.70	12.34	5.92	8.52	10.98
2023	11.05	9.91	7.96	7.94	11.26	11.70	12.41	5.57	8.31	10.72
2024	11.15	9.91	7.43	8.12	11.13	11.83	12.42	5.56	7.92	10.83
2025	10.58	9.90	8.76	9.15	11.13	11.30	11.86	5.73	8.34	10.98
2026	9.42	9.90	9.15	9.16	10.10	10.01	10.50	6.38	8.60	10.78
2027	9.54	9.89	9.00	8.97	10.13	10.17	10.57	5.85	8.48	10.91
2028	9.53	9.78	8.86	8.91	10.13	10.11	10.69	5.83	8.25	11.00
2029	9.81	10.09	8.08	9.33	10.48	10.44	11.07	5.93	8.36	11.28
2030	9.92	9.99	7.78	8.69	10.51	10.55	11.27	6.22	8.22	11.38
2031	9.91	9.93	7.84	7.95	10.47	10.51	11.32	6.34	8.16	11.58
2032	10.01	9.77	7.95	7.82	10.47	10.30	11.61	6.28	7.85	11.56
2033	10.01	9.72	8.21	7.71	10.49	10.39	11.74	6.39	7.66	11.87
2034	9.92	9.59	8.38	7.76	10.32	10.35	11.78	6.43	7.39	11.76
2035	10.06	9.47	8.53	7.45	10.38	10.57	12.08	6.49	7.04	11.66

Emission PSE Portfolio, Sensitivity - All (Millions Tons), 2013 Planning Standard

	No DSR	Bundle E	Bundle F	Bundle G
2016	10.19	10.14	10.14	10.13
2017	10.27	10.11	10.11	13.20
2018	10.45	10.17	10.17	13.28
2019	10.33	9.92	9.91	13.10
2020	10.48	9.95	9.94	13.20
2021	10.71	10.06	10.05	13.31
2022	10.63	9.98	9.97	13.14
2023	10.53	9.87	9.86	13.06
2024	10.75	9.86	9.85	13.07
2025	10.84	9.85	9.84	12.39
2026	10.81	9.84	9.83	9.64
2027	10.94	9.94	9.92	9.74
2028	10.86	9.71	9.70	9.63
2029	11.22	10.02	10.00	9.93
2030	11.05	9.91	9.89	9.82
2031	11.03	9.84	9.83	9.76
2032	10.89	9.69	9.67	9.60
2033	10.90	9.64	9.62	9.59
2034	10.80	9.50	9.49	9.42
2035	10.72	9.38	9.36	9.29

Figure N-36: Emission PSE Portfolio - WA (Millions Tons), 2013 Planning Standard

	Low	Base	High	Base + Low Gas Price	Base + High Gas Price	Base + Very High Gas Price	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
2016	1.33	0.74	2.29	1.65	1.03	0.49	1.19	1.19	0.51	1.06
2017	1.27	0.66	3.08	1.51	0.80	0.38	1.07	1.08	0.42	0.95
2018	0.98	0.61	2.66	1.31	0.61	0.40	1.10	1.12	0.36	0.90
2019	1.07	0.75	2.69	1.66	0.64	0.48	1.20	1.27	0.44	1.15
2020	1.06	0.84	1.45	1.65	0.57	0.51	1.36	1.66	0.50	1.20
2021	1.33	1.19	1.76	1.82	0.80	0.75	2.06	1.76	0.63	1.71
2022	1.10	1.29	2.19	1.58	0.88	0.81	2.36	1.89	0.66	1.83
2023	1.37	1.28	3.33	2.22	0.98	0.79	2.54	1.97	0.63	1.88
2024	0.89	1.32	3.18	1.79	0.98	0.99	2.75	2.88	0.63	1.85
2025	0.78	1.06	2.94	1.63	0.80	0.77	2.30	2.84	0.49	1.60
2026	1.20	0.98	3.44	2.60	0.85	0.71	3.03	3.24	0.37	2.32
2027	1.20	0.96	3.58	3.53	0.85	0.71	3.99	3.20	0.37	2.33
2028	1.20	1.01	5.00	3.61	0.82	0.61	4.24	3.35	0.36	3.37
2029	1.06	1.00	4.81	3.39	0.86	0.63	4.41	3.25	0.35	3.14
2030	1.25	1.03	5.05	3.66	0.79	0.59	4.59	4.11	0.32	3.19
2031	1.70	1.02	6.77	3.89	0.79	0.46	5.03	4.25	0.41	4.37
2032	2.00	1.01	6.82	3.92	0.82	0.51	5.25	4.25	0.44	4.19
2033	2.10	1.08	7.71	4.01	0.73	0.47	5.46	4.39	0.47	5.24
2034	2.36	1.08	7.78	3.98	0.70	0.45	5.63	4.31	0.52	5.19
2035	2.54	0.96	7.70	3.90	0.65	0.43	5.87	4.31	0.50	5.16

Electric Integrated Portfolio Results–2015 Optimal Planning Standard

This table summarizes the expected costs of the different portfolios.

Figure N-37: Revenue Requirements for Optimal Portfolio with Expected Inputs for the Scenario, 2015 Optimal Planning Standard

Expected Cost for All Portfolios

Scenario	NPV to 2016 ($Millions)						
	Expected Portfolio Cost	Net Market Purchases / (Sales)	DSR Rev. Req.	Generic Rev. Req.	Generic End Effects	Variable Cost of Existing	REC Revenue
Base	$12,789	$3,790	$967	$2,104	$980	$4,956	($11)
Low	$7,669	$1,550	$1,082	$780	$516	$3,756	($16)
High	$17,991	$2,431	$1,134	$7,866	$747	$5,885	($76)
Base + Low Gas	$12,038	$2,991	$967	$2,132	$990	$4,967	($11)
Base + High Gas	$13,411	$4,713	$967	$1,584	$993	$5,163	($11)
Base + Very High Gas	$14,180	$5,459	$1,186	$1,622	$844	$5,091	($23)
Base + No CO2	$10,379	-$190	$967	$3,965	$775	$4,873	($11)
Base + High CO2	$13,948	$3,071	$967	$4,841	$641	$4,444	($17)
Base + Low Demand	$10,204	$3,882	$967	$835	$537	$4,000	($16)
Base + High Demand	$16,091	$3,410	$916	$4,419	$1,617	$5,744	($18)

Figure N-38: Annual Revenue Requirements for Optimal Portfolio ($Millions)
2015 Optimal Planning Standard

	Base	Low	High	Base + Low Gas	Base + High Gas	Base + Very High Gas	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
2016	720	533	666	679	722	789	605	606	669	773
2017	767	574	773	743	783	844	645	646	709	874
2018	809	631	864	782	841	890	678	679	746	919
2019	801	585	888	766	853	886	667	667	730	967
2020	845	660	1,281	816	909	941	699	972	770	1,012
2021	902	610	1,375	871	969	1,010	789	1,080	771	1,083
2022	945	638	1,422	916	999	1,066	816	1,131	805	1,137
2023	1,042	616	1,615	982	1,091	1,165	849	1,188	813	1,322
2024	1,108	718	1,665	1,066	1,157	1,235	899	1,262	906	1,353
2025	1,180	752	1,775	1,142	1,252	1,291	1,004	1,415	963	1,440
2026	1,323	705	2,011	1,200	1,354	1,410	1,096	1,625	1,012	1,613
2027	1,395	717	2,149	1,270	1,497	1,503	1,143	1,713	1,100	1,664
2028	1,450	735	2,351	1,321	1,553	1,657	1,171	1,786	1,135	1,843
2029	1,620	852	2,596	1,490	1,677	1,808	1,241	1,938	1,230	1,973
2030	1,685	859	2,712	1,525	1,799	1,907	1,377	2,049	1,278	2,062
2031	1,792	910	2,933	1,614	1,893	2,115	1,438	2,277	1,370	2,333
2032	1,857	919	3,105	1,678	1,978	2,268	1,458	2,373	1,404	2,439
2033	2,015	940	3,395	1,831	2,083	2,392	1,507	2,489	1,483	2,678
2034	2,098	957	3,594	1,904	2,241	2,520	1,544	2,599	1,525	2,799
2035	2,181	967	3,828	1,980	2,340	2,683	1,569	2,724	1,565	2,945
20-yr NPV	11,808	7,153	17,244	11,048	12,418	13,336	9,604	13,307	9,668	14,474
End Effects	980	516	747	990	993	844	775	641	537	1,617
Expected Cost	12,789	7,669	17,991	12,038	13,411	14,180	10,379	13,948	10,204	16,091

Figure N-39: Incremental Portfolio Builds by Year (nameplate MW)
2015 Optimal Planning Standard

Base, Base + Low Gas Price

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	-	228	-	-	50	-	62	2
2022	-	-	-	-	100	-	66	2
2023	-	228	100	-	-	-	56	2
2024	-	-	100	-	-	-	55	2
2025	-	228	-	-	-	-	53	2
2026	385	-	-	-	-	-	27	2
2027	-	-	100	-	-	-	27	2
2028	-	-	-	-	-	-	27	2
2029	-	228	-	-	-	-	23	2
2030	-	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	228	-	15	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	385	1,138	300	15	150	-	906	148

Incremental Portfolio Builds by Year (nameplate MW), 2015 Optimal Planning Standard

Base + High Gas Price

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	-	228	-	-	50	-	62	2
2022	-	-	-	-	100	-	66	2
2023	-	228	100	-	-	-	56	2
2024	-	-	100	-	-	-	55	2
2025	-	228	-	-	-	-	53	2
2026	-	228	-	-	-	-	27	2
2027	-	228	100	-	-	-	27	2
2028	-	-	-	-	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	-	228	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	-	-	15	-	-	29	2
2034	-	228	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	-	1,593	300	15	150	-	906	148

Incremental Portfolio Builds by Year (nameplate MW), 2015 Optimal Planning Standard

Base + Very High Gas Price

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	77	18
2017	-	-	-	-	-	-	66	12
2018	-	-	-	-	-	-	71	39
2019	-	-	-	-	-	-	69	14
2020	-	-	-	-	-	-	84	35
2021	-	228	-	-	25	-	68	2
2022	-	-	-	-	75	-	72	2
2023	-	228	100	-	-	-	61	2
2024	-	-	100	-	-	-	59	2
2025	-	-	100	-	-	-	58	2
2026	-	455	-	-	-	-	28	2
2027	-	-	-	-	-	-	30	2
2028	-	228	-	-	-	-	29	2
2029	-	-	-	-	-	-	25	2
2030	-	-	-	-	-	-	25	2
2031	-	228	-	-	-	-	29	2
2032	-	-	200	-	-	-	35	2
2033	-	-	-	-	-	-	31	2
2034	-	-	-	-	-	-	26	2
2035	-	-	-	-	-	80	25	2
Total	-	1,366	500	-	100	80	968	148

Incremental Portfolio Builds by Year (nameplate MW), 2015 Optimal Planning Standard Low

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	24
2017	-	-	-	-	-	-	62	12
2018	-	-	-	-	-	-	66	65
2019	-	-	-	-	-	-	63	14
2020	-	-	-	-	-	-	77	69
2021	-	-	-	-	-	-	60	3
2022	-	-	-	-	-	-	64	3
2023	-	-	-	-	-	-	55	3
2024	-	-	200	-	-	-	54	3
2025	-	228	-	-	-	-	51	3
2026	-	228	-	-	-	-	26	3
2027	-	-	-	-	-	-	27	3
2028	-	-	-	-	-	-	27	3
2029	-	228	-	-	-	-	23	3
2030	-	-	-	-	-	-	23	3
2031	-	-	-	-	-	-	26	3
2032	-	-	-	-	-	-	32	3
2033	-	-	-	-	-	-	29	3
2034	-	-	-	-	-	-	24	3
2035	-	-	-	-	-	-	24	3
Total	-	683	200	-	-	-	888	230

Incremental Portfolio Builds by Year (nameplate MW), 2015 Optimal Planning Standard

Base + Low Demand

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	-	-	-	-	-	-	62	2
2022	-	-	-	-	-	-	66	2
2023	-	-	-	-	-	-	56	2
2024	-	-	200	-	-	-	55	2
2025	-	228	-	-	-	-	53	2
2026	-	228	-	-	-	-	27	2
2027	-	228	-	-	-	-	27	2
2028	-	-	-	-	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	-	-	-	-	80	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	-	683	200	-	-	80	906	148

Incremental Portfolio Builds by Year (nameplate MW), 2015 Optimal Planning Standard

Base + No CO_2

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	385	-	-	-	-	-	62	2
2022	-	-	-	-	-	-	66	2
2023	-	-	100	-	-	-	56	2
2024	-	-	100	-	-	-	55	2
2025	385	-	-	-	-	-	53	2
2026	385	-	-	-	-	-	27	2
2027	-	-	100	-	-	-	27	2
2028	-	-	-	-	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	385	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	-	-	15	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	1,542	-	300	15	-	-	906	148

Incremental Portfolio Builds by Year (nameplate MW), 2015 Optimal Planning Standard

Base + High CO_2

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	385	-	-	-	-	-	62	2
2022	-	-	-	-	-	-	66	2
2023	-	-	100	-	-	-	56	2
2024	-	-	100	-	-	-	55	2
2025	385	-	-	-	-	-	53	2
2026	385	-	-	-	-	-	27	2
2027	-	-	100	-	-	-	27	2
2028	-	-	-	-	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	-	-	100	-	-	-	23	2
2031	385	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	-	-	-	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	1,542	-	400	-	-	-	906	148

Incremental Portfolio Builds by Year (nameplate MW), 2015 Optimal Planning Standard High

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	DSR	DR
2016	-	-	-	-	-	-	75	24
2017	-	228	-	-	75	-	64	12
2018	-	-	-	-	50	-	67	65
2019	-	-	100	-	100	-	64	14
2020	-	-	-	-	25	-	79	69
2021	385	-	-	-	25	-	62	3
2022	-	-	-	-	50	-	66	3
2023	385	-	300	-	-	-	56	3
2024	-	-	-	-	-	-	55	3
2025	-	-	-	-	-	-	53	3
2026	385	-	-	-	-	-	27	3
2027	-	-	200	-	-	-	27	3
2028	385	-	-	-	-	-	27	3
2029	-	-	400	-	-	-	23	3
2030	-	-	-	-	-	-	23	3
2031	385	-	-	-	-	-	27	3
2032	-	-	-	-	-	-	32	3
2033	385	-	-	-	-	-	29	3
2034	-	-	-	-	-	-	25	3
2035	-	-	-	-	-	-	24	3
Total	2,312	228	1,000	-	325	-	906	230

Incremental Portfolio Builds by Year (nameplate MW), 2015 Optimal Planning Standard

Base + High Demand

Annual Builds (MW)	CCCT	Frame Peaker	WA Wind	Biomass	PBA	Battery	Solar	DSR	DR
2016	-	-	-	-	-	-	-	75	18
2017	-	228	-	-	75	-	-	62	12
2018	-	-	-	-	75	-	-	66	39
2019	-	228	-	-	-	-	-	63	14
2020	-	-	-	-	-	-	-	77	35
2021	-	228	-	-	50	-	-	60	2
2022	-	-	-	-	75	-	-	64	2
2023	-	228	400	-	-	-	-	55	2
2024	-	-	-	-	-	-	-	54	2
2025	-	228	-	-	-	-	-	51	2
2026	385	-	-	-	-	-	-	26	2
2027	-	-	-	-	-	-	-	27	2
2028	385	-	-	-	-	-	-	27	2
2029	-	-	-	-	-	-	-	23	2
2030	-	-	-	-	-	-	-	23	2
2031	385	-	100	-	-	-	-	26	2
2032	-	-	-	-	-	-	-	32	2
2033	385	-	-	-	-	-	-	29	2
2034	-	-	-	-	-	-	-	24	2
2035	-	-	-	-	-	-	20	24	2
Total	1,542	1,138	500	-	275	-	20	888	148

Figure N -40: Emission PSE Portfolio - All (Millions Tons), 2015 Optimal Planning Standard

	Low	Base	High	Base + Low Gas Price	Base + High Gas Price	Base + Very High Gas Price	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
2016	10.89	10.14	12.34	9.08	10.36	11.24	11.69	11.60	9.31	11.10
2017	11.57	10.12	12.95	9.42	11.11	11.78	12.24	12.14	9.18	11.26
2018	11.53	10.18	12.99	9.23	11.38	11.75	12.28	12.15	9.11	11.29
2019	11.25	9.93	12.79	8.61	11.63	11.69	12.13	11.97	8.67	11.00
2020	11.42	9.97	10.51	9.00	11.77	11.79	12.29	6.28	8.61	11.14
2021	11.37	10.09	10.39	9.19	11.72	11.81	12.33	6.20	8.79	11.36
2022	11.18	10.01	9.01	9.08	11.32	11.70	12.33	6.12	8.50	11.26
2023	11.05	9.91	8.16	7.94	11.26	11.82	12.40	5.98	8.30	10.78
2024	10.92	9.91	7.62	8.12	11.13	11.83	12.40	5.69	7.90	10.90
2025	10.58	9.90	8.96	9.15	11.13	11.18	11.84	6.06	8.32	11.05
2026	9.42	9.92	9.36	9.16	10.10	9.90	10.50	6.70	8.58	10.86
2027	9.54	9.91	9.00	8.94	10.13	10.05	10.57	6.09	8.46	10.99
2028	9.53	9.81	8.86	8.87	10.13	10.11	10.70	6.09	8.23	11.09
2029	9.81	10.11	8.08	9.29	10.48	10.44	11.08	6.18	8.34	11.38
2030	9.92	10.02	7.77	8.65	10.51	10.55	11.26	6.20	8.20	11.48
2031	9.91	9.96	7.84	7.90	10.47	10.51	11.33	6.53	8.13	11.58
2032	10.01	9.83	7.94	7.74	10.47	10.42	11.67	6.59	7.82	11.67
2033	10.01	9.80	8.20	7.62	10.49	10.50	11.80	6.71	7.63	11.98
2034	9.92	9.67	8.38	7.66	10.32	10.46	11.85	6.75	7.36	11.88
2035	10.06	9.56	8.53	7.34	10.38	10.68	12.13	6.82	7.01	11.77

Emission PSE Portfolio - WA (Millions Tons), 2015 Optimal Planning Standard

	Low	Base	High	Base + Low Gas Price	Base + High Gas Price	Base + Very High Gas Price	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
2016	1.33	0.74	2.29	1.65	1.03	0.49	1.19	1.19	0.51	1.06
2017	1.27	0.66	2.28	1.51	0.80	0.38	1.07	1.08	0.42	0.95
2018	0.98	0.61	1.96	1.31	0.61	0.40	1.10	1.12	0.36	0.90
2019	1.07	0.75	1.97	1.66	0.64	0.48	1.20	1.27	0.44	1.15
2020	1.06	0.84	0.91	1.65	0.57	0.51	1.36	1.66	0.50	1.20
2021	1.33	1.19	1.87	1.82	0.80	0.75	2.79	2.65	0.63	1.71
2022	1.10	1.29	2.28	1.58	0.88	0.81	3.15	2.79	0.66	1.83
2023	1.37	1.28	3.37	2.22	0.98	0.79	3.39	2.88	0.63	1.88
2024	0.89	1.32	3.22	1.79	0.98	0.99	3.63	2.86	0.63	1.85
2025	0.78	1.06	3.03	1.63	0.80	0.77	3.95	3.74	0.49	1.60
2026	1.20	1.61	3.53	2.60	0.85	0.71	4.66	4.09	0.37	2.32
2027	1.20	1.60	3.67	2.63	0.85	0.71	4.81	4.04	0.37	2.33
2028	1.20	1.66	5.05	2.72	0.82	0.61	5.08	4.21	0.36	3.37
2029	1.06	1.66	4.86	2.52	0.86	0.63	5.26	4.07	0.35	3.14
2030	1.25	1.71	5.08	2.79	0.79	0.59	6.35	4.11	0.32	3.19
2031	1.70	1.74	6.78	2.95	0.79	0.46	6.98	5.12	0.41	4.37
2032	2.00	1.71	6.83	3.00	0.82	0.51	7.24	5.12	0.44	4.19
2033	2.10	1.82	7.74	3.08	0.73	0.47	7.47	5.27	0.47	5.24
2034	2.36	1.84	7.80	3.06	0.70	0.45	7.66	5.17	0.52	5.19
2035	2.54	1.73	7.72	2.99	0.65	0.43	7.92	5.18	0.50	5.16

Candidate Resource Strategy Results

This table summarizes the expected costs of the different candidate resource strategies.

Figure N-41: Revenue Requirements for Optimal Portfolio with Expected Inputs for the Scenario Expected Cost for All Portfolios

Scenario	NPV to 2016 ($Millions)						
	Expected Portfolio Cost	Net Market Purchases / (Sales)	DSR Rev. Req.	Generic Rev. Req.	Generic End Effects	Variable Cost of Existing	REC Revenue
1 - All Frame Peaker	$12,531	$4,251	$967	$2,371	$911	$4,956	($14)
2 - Early Recip Peaker	$12,620	$4,251	$967	$2,460	$922	$4,956	($14)
3 - Early CCCT/Thermal Mix	$12,729	$3,259	$967	$3,561	$962	$4,956	($14)
4 - All CCCT	$12,761	$2,501	$967	$4,351	$921	$4,956	($14)
5 - Mix CCCT & Frame Peaker	$12,627	$3,456	$967	$3,262	$921	$4,956	($14)
6 - Add 300 MW Wind in 2021	$12,798	$3,903	$967	$3,051	$978	$4,956	($79)

Figure N-42 : Annual Revenue Requirements for Optimal Portfolio ($Millions)

	1 - All Frame Peaker	2 - Early Recip Peaker	3 - Early CCCT/Thermal Mix	4 - All CCCT	5 - Mix CCCT & Frame Peaker	6 - Add 300 MW Wind in 2021
2016	720	720	720	720	720	720
2017	767	767	767	767	767	767
2018	809	809	809	809	809	809
2019	801	801	801	801	801	801
2020	845	845	845	845	845	845
2021	912	926	925	925	912	981
2022	953	967	965	965	953	1,013
2023	1,029	1,042	1,040	1,040	1,029	1,079
2024	1,067	1,080	1,077	1,077	1,067	1,111
2025	1,116	1,129	1,127	1,287	1,116	1,154
2026	1,239	1,251	1,270	1,321	1,314	1,266
2027	1,340	1,352	1,379	1,368	1,362	1,363
2028	1,432	1,444	1,469	1,457	1,452	1,453
2029	1,546	1,558	1,581	1,569	1,565	1,563
2030	1,663	1,675	1,696	1,691	1,679	1,677
2031	1,771	1,782	1,801	1,796	1,786	1,781
2032	1,835	1,846	1,864	1,858	1,849	1,843
2033	1,983	1,994	2,022	2,011	2,004	1,987
2034	2,067	2,078	2,103	2,089	2,086	2,066
2035	2,153	2,163	2,186	2,171	2,168	2,148
20-yr NPV	11,620	11,698	11,767	11,840	11,707	11,820
End Effects	911	922	962	921	921	978
Expected Cost	12,531	12,620	12,729	12,761	12,627	12,798

Figure N-43: Revenue Requirement with Input Simulations – 1,000 Trials

Expected Portfolio Cost ($Millions)	Risk Simulation - 1000 Trials					
	1 - All Frame Peaker	2 - Early Recip Peaker	3 - Early CCCT/Thermal Mix	4 - All CCCT	5 - Mix CCCT & Frame Peaker	6 - Add 300 MW Wind in 2021
Minimum	$7,604	$8,214	$7,815	$7,549	$7,554	$7,554
1st Quartile (P25)	$9,974	$10,378	$10,008	$9,710	$9,767	$10,326
Mean	$11,343	$11,782	$11,392	$10,993	$11,138	$11,582
Median (P50)	$11,371	$11,791	$11,413	$11,052	$11,179	$11,605
3rd Quartile (P75)	$12,586	$13,052	$12,499	$12,048	$12,243	$12,638
TVar90	$14,589	$15,014	$14,412	$13,856	$14,147	$14,576
Maximum	$16,275	$16,750	$16,103	$15,545	$15,875	$16,188
Base Deterministic	$12,531	$12,620	$12,729	$12,761	$12,627	$12,798

Figure N-44: Incremental Portfolio Builds by Year (nameplate MW)

Option 1 - All Frame Peaker Portfolio

Annual Builds (MW)	CCCT	Frame Peaker	Recip Peaker	WA Wind	Biomass	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	-	277	-	-	-	-	62	2
2022	-	-	-	-	-	-	66	2
2023	-	-	-	206	-	-	56	2
2024	-	-	-	-	-	-	55	2
2025	-	126	-	-	-	-	53	2
2026	-	363	-	-	-	-	27	2
2027	-	214	-	-	-	-	27	2
2028	-	-	-	131	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	-	206	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	228	-	-	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	-	1,413	-	337	-	-	906	148

Incremental Portfolio Builds by Year (nameplate MW)

Option 2 - Early Recip Peaker

Annual Builds (MW)	CCCT	Frame Peaker	Recip Peaker	WA Wind	Biomass	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	-	-	277	-	-	-	62	2
2022	-	-	-	-	-	-	66	2
2023	-	-	-	206	-	-	56	2
2024	-	-	-	-	-	-	55	2
2025	-	126	-	-	-	-	53	2
2026	-	363	-	-	-	-	27	2
2027	-	214	-	-	-	-	27	2
2028	-	-	-	131	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	-	206	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	228	-	-	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	-	1,136	227	337	-	-	906	148

Incremental Portfolio Builds by Year (nameplate MW)

Option 3 - Early CCCT/Thermal Mix

Annual Builds (MW)	CCCT	Frame Peaker	Recip Peaker	WA Wind	Biomass	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	277	-	-	-	-	-	62	2
2022	-	-	-	-	-	-	66	2
2023	-	-	-	206	-	-	56	2
2024	-	-	-	-	-	-	55	2
2025	-	126	-	-	-	-	53	2
2026	385	-	-	-	-	-	27	2
2027	-	-	207	-	-	-	27	2
2028	-	-	-	131	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	-	206	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	-	225	-	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	662	332	432	337	-	-	906	148

Incremental Portfolio Builds by Year (nameplate MW)

Option 4 - All CCCT

Annual Builds (MW)	CCCT	Frame Peaker	Recip Peaker	WA Wind	Biomass	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	277	-	-	-	-	-	62	2
2022	-	-	-	-	-	-	66	2
2023	-	-	-	206	-	-	56	2
2024	-	-	-	-	-	-	55	2
2025	703	-	-	-	-	-	53	2
2026	-	-	-	-	-	-	27	2
2027	-	-	-	-	-	-	27	2
2028	-	-	-	131	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	206	-	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	228	-	-	-	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	1,414	-	-	337	-	-	906	148

Incremental Portfolio Builds by Year (nameplate MW)

Option 5 - Mix CCCT & Frame Peaker

Annual Builds (MW)	CCCT	Frame Peaker	Recip Peaker	WA Wind	Biomass	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	-	277	-	-	-	-	62	2
2022	-	-	-	-	-	-	66	2
2023	-	-	-	206	-	-	56	2
2024	-	-	-	-	-	-	55	2
2025	-	126	-	-	-	-	53	2
2026	577	-	-	-	-	-	27	2
2027	-	-	-	-	-	-	27	2
2028	-	-	-	131	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	-	206	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	228	-	-	-	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	805	609	-	337	-	-	906	148

Incremental Portfolio Builds by Year (nameplate MW)

Option 6 - Add 300 MW Wind in 2021

Annual Builds (MW)	CCCT	Frame Peaker	Recip Peaker	WA Wind	Biomass	Battery	DSR	DR
2016	-	-	-	-	-	-	75	18
2017	-	-	-	-	-	-	64	12
2018	-	-	-	-	-	-	67	39
2019	-	-	-	-	-	-	64	14
2020	-	-	-	-	-	-	79	35
2021	-	253	-	300	-	-	62	2
2022	-	-	-	-	-	-	66	2
2023	-	-	-	206	-	-	56	2
2024	-	-	-	-	-	-	55	2
2025	-	126	-	-	-	-	53	2
2026	-	363	-	-	-	-	27	2
2027	-	214	-	-	-	-	27	2
2028	-	-	-	131	-	-	27	2
2029	-	-	-	-	-	-	23	2
2030	-	206	-	-	-	-	23	2
2031	-	-	-	-	-	-	27	2
2032	-	-	-	-	-	-	32	2
2033	-	228	-	-	-	-	29	2
2034	-	-	-	-	-	-	25	2
2035	-	-	-	-	-	-	24	2
Total	-	1,389	-	637	-	-	906	148

Figure N - 45: Emission PSE Portfolio - All (Millions Tons)

	1 - All Frame Peaker	2 - Early Recip	3 - Early CCCT/Thermal Mix	4 - All CCCT	5 - Mix CCCT & Frame Peaker	6 - Add 300 MW Wind in 2021
2016	10.14	10.14	10.14	10.14	10.14	10.14
2017	10.12	10.12	10.12	10.12	10.12	10.12
2018	10.18	10.18	10.18	10.18	10.18	10.18
2019	9.93	9.93	9.93	9.93	9.93	9.93
2020	9.97	9.97	9.97	9.97	9.97	9.97
2021	10.09	10.09	10.10	10.10	10.09	9.75
2022	10.01	10.01	10.03	10.03	10.01	9.68
2023	9.79	9.79	9.81	9.81	9.79	9.45
2024	9.90	9.90	9.92	9.92	9.90	9.56
2025	9.90	9.90	9.92	9.97	9.90	9.57
2026	9.89	9.89	9.93	9.95	9.92	9.56
2027	9.99	9.99	10.03	10.05	10.02	9.66
2028	9.74	9.74	9.80	9.82	9.78	9.41
2029	10.05	10.05	10.10	10.13	10.09	9.72
2030	9.95	9.95	10.01	10.06	10.00	9.62
2031	9.88	9.88	9.95	10.01	9.94	9.56
2032	9.73	9.73	9.84	9.92	9.82	9.42
2033	9.72	9.72	9.85	10.00	9.87	9.41
2034	9.59	9.59	9.74	9.90	9.76	9.28
2035	9.47	9.47	9.63	9.81	9.66	9.17

Emission PSE Portfolio - WA (Millions Tons)

	1 - All Frame Peaker	2 - Early Recip	3 - Early CCCT/Thermal Mix	4 - All CCCT	5 - Mix CCCT & Frame Peaker	6 - Add 300 MW Wind in 2021
2016	0.74	0.74	0.74	0.74	0.74	0.74
2017	0.66	0.66	0.66	0.66	0.66	0.66
2018	0.61	0.61	0.61	0.61	0.61	0.61
2019	0.75	0.75	0.75	0.75	0.75	0.75
2020	0.84	0.84	0.84	0.84	0.84	0.84
2021	1.19	1.19	1.67	1.67	1.19	1.19
2022	1.29	1.29	1.78	1.78	1.29	1.29
2023	1.28	1.28	1.80	1.80	1.28	1.28
2024	1.32	1.32	1.82	1.82	1.32	1.32
2025	1.06	1.06	1.52	2.84	1.06	1.06
2026	0.98	0.98	2.06	2.63	1.93	0.98
2027	0.96	0.96	2.02	2.56	1.91	0.96
2028	1.01	1.01	2.10	2.69	1.98	1.01
2029	1.00	1.00	2.10	2.68	1.98	1.00
2030	1.03	1.03	2.15	3.14	2.05	1.03
2031	1.02	1.02	2.22	3.26	2.09	1.02
2032	1.01	1.01	2.18	3.20	2.06	1.01
2033	1.08	1.08	2.32	3.81	2.64	1.08
2034	1.08	1.08	2.36	3.92	2.68	1.08
2035	0.96	0.96	2.26	3.83	2.59	0.96

INCREMENTAL COST OF RENEWABLE RESOURCES

According to RCW 19.285, certain electric utilities in Washington must meet 15 percent of their retail electric load with eligible renewable resources by the calendar year 2020. The annual target for the calendar year 2012 was 3 percent of retail electric load, and for 2016, it is 9 percent. However, if the incremental cost of those renewable resources compared to an equivalent non-renewable is greater than 4 percent of its revenue requirement, then a utility will be considered in compliance with the annual renewable energy target in RCW 19.285. The law states it this way: "The incremental cost of an eligible renewable resource is calculated as the difference between the levelized delivered cost of the eligible renewable resource, regardless of ownership, compared to the levelized delivered cost of an equivalent amount of reasonably available substitute resources that do not qualify as eligible renewable resources."[9]

Analytic Framework. This analysis compares the revenue requirement cost of each renewable resource with the projected market value and capacity value at the time of the renewable acquisition. There may be other approaches to calculating these costs – such as using variable costs from different kinds of thermal plants instead of market. However, PSE's approach is most reasonable because it most closely reflects how customers will experience costs; i.e., PSE would not dispatch a peaker or CCCT with the ramping up and down of a wind farm without regard to whether the unit is being economically dispatched. For example, a peaker will not be economically dispatched often at all, so capacity from the thermal plant and energy from market is the closest match to actual incremental costs – and that is the point of this provision in the law – a to ensure customers don't pay too much. This, "contemporaneous" with the decision-making aspect of PSE's approach, is important. Utilities should be able to assess whether they will exceed the cost cap before an acquisition, without having to worry about ex-post adjustments that could change compliance status. The analytical framework here reflects a close approximation of the portfolio analysis used by PSE in resource planning, as well as in the evaluation of bids received in response to the company's request for proposals (RFP).

9 / RCW 19.285.050 (1) (a) (b)

"Eligible Renewable Resources"

Figure N-46: Resources that meet RCW 19.285 definition of Eligible Renewable Resource

	Nameplate (MW)	Annual Energy (aMW)	Commercial Online Date	Market Price/ Peaker Assumptions	Capacity Credit Assumption
Hopkins Ridge	149.4	53.3	Dec 2005	2004 RFP	20%
Wild Horse	228.6	73.4	Dec 2006	2006 RFP	17.2%
Klondike III	50	18.0	Dec 2007	2006 RFP	15.6%
Hopkins Infill	7.2	2.4	Dec 2007	2007 IRP	20%
Wild Horse Expansion	44	10.5	Dec 2009	2007 IRP	15%
Lower Snake River I	342.7	102.5	Apr 2012	2010 Trends	5%
Snoqualmie Upgrades	6.1	3.9	Mar 2013	2009 Trends	95%
Lower Baker Upgrades	30	12.5	May 2013	2011 IRP Base	95%
Generic Wind 2023	206	71	Jan 2023	2015 IRP Base	8%
Generic Wind 2028	131	45	Jan 2028	2015 IRP Base	8%

Equivalent Non-renewable. The incremental cost of a renewable resource is defined as the difference between the levelized cost of the renewable resource compared to an equivalent non-renewable resource. An equivalent non-renewable is an energy resource that does not meet the definition of a renewable resource in RCW 19.285, but is equal to a renewable resource on an energy and capacity basis. For the purpose of this analysis, the cost of an equivalent non-renewable resource has three components:

1. **Capacity Cost:** There are two parts of capacity cost. First is the capacity in MW. This would be nameplate for a firm resource like biomass, or the assumed capacity of a wind plant. Second is the $/kW cost, which we assumed to be equal to the cost of a peaker.
2. **Energy Cost:** This was calculated by taking the hourly generation shape of the resource, multiplied by the market price in each hour. This is the equivalent cost of purchasing the equivalent energy on the market.
3. **Imputed Debt:** The law states the non-renewable must be an "equivalent amount," which includes a time dimension. If PSE entered into a long-term contract for energy, there would be an element of imputed debt. Therefore, it is included in this analysis as a cost for the non-renewable equivalent.

For example, Hopkins Ridge produces 466,900 MWh annually. The equivalent non renewable is to purchase 466,900 MWh from the Mid-C market and then build a 30 MW (149.4*20 percent = 30) peaker plant for capacity only. With the example, the cost comparison includes the hourly

Mid-C price plus the cost of building a peaker, plus the cost of the imputed debt. The total revenue requirement (fixed and variable costs) of the non-renewable is the cost stream – including end effects – discounted back to the first year. That net present value is then levelized over the life of the comparison renewable resource.

Cost of Renewable Resource. Levelized cost of the renewable resource is more direct. It is based on the proforma financial analysis performed at the time of the acquisition. The stream of revenue requirement (all fixed and variable costs, including integration costs) are discounted back to the first year – again, including end effects. That net present value is then levelized out over the life of the resource/contract. The levelized cost of the renewable resource is then compared with the levelized cost of the equivalent non-renewable resource to calculate the incremental cost.

The following is a detailed example of how PSE calculated the incremental cost of Wild Horse. It is important to note that PSE's approach uses information contemporaneous with the decision making process, so this analysis will not reflect updated assumptions for capacity, capital cost, or integration costs, etc.

Eligible Renewable: Wild Horse Wind Facility
Capacity Contribution Assumption: 228.6 * 17.2% = 39 MW

1. Calculate Wild Horse revenue requirement.

Figure N-47 is a sample of the annual revenue requirement calculations for the first few years of Wild Horse, along with the NPV of revenue requirement.

Figure N-47: Calculation of Wild Horse Revenue Requirement

($ Millions)	20-yr NPV	2007	2008	…	2025
Gross Plant		384	384	…	384
Accumulative depreciation (Avg.)		(10)	(29)	…	(355)
Accumulative deferred tax (EOP)		(20)	(56)	…	(7)
Rate base		354	299	…	22
After tax WACC		7.01%	7.01%	…	7.01%
After tax return		25	21	…	2
Grossed up return		38	32	…	2
PTC grossed up		(20)	(20)	…	-
Expenses		16	16	…	22
Book depreciation		19	19	…	19
Revenue required	370.9	53	48	…	44
End effects	4.6				
Total revenue requirement	375				

2. Calculate revenue requirement for equivalent non-renewable: Peaker capacity.

Capacity = 39 MW

Capital Cost of Capacity: $462/KW

Figure N-48: Calculation of Peaker Revenue Requirement

($ Millions)	20-yr NPV	2007	2008	…	2025
Gross Plant		18	18	…	18
Accumulative depreciation (Avg.)		(0)	(1)	…	(10)
Accumulative deferred tax (EOP)		(0)	(0)	…	(3)
Rate base		18	17	…	5
After tax WACC		7.01%	7.01%	…	7.01%
After tax return		1	1	…	0
Grossed up return		2	2	…	0
Expenses		1	1	…	2
Book depreciation		1	1	…	1
Revenue required	32	4	4	…	3
End effects	2				
Total revenue requirement	34				

3. Calculate revenue requirement for equivalent non-renewable: Energy

Energy: 642,814 MWh

For the market purchase, we used the hourly power prices from the 2006 RFP plus a transmission adder of $1.65/MWh in 2007 and escalated at 2.5 percent.

Figure N-49: Calculation of Energy Revenue Requirement

Month	Day	Hour	20-yr NPV	2007	...	2025
1	1	1		49 MW * $59/MW = $2891	...	49 MW * $61/MW = $2989
1	1	2		92 MW * $60/MW = $5520	...	92 MW * $63/MW = $5796
...	....	...		...	...	...
12	31	24		13 MW * $59/MW = $767	...	13 MW * $65/MW = $845
($Millions)						
Cost of Market				36	...	41
Imputed Debt				1	...	0
Total Revenue Requirement			285	37	...	41

4. Incremental cost

The table below is the total cost of Wild Horse less the cost of the peaker and less the cost of the market purchases for the total 20-year incremental cost difference of the renewable to an equivalent non-renewable.

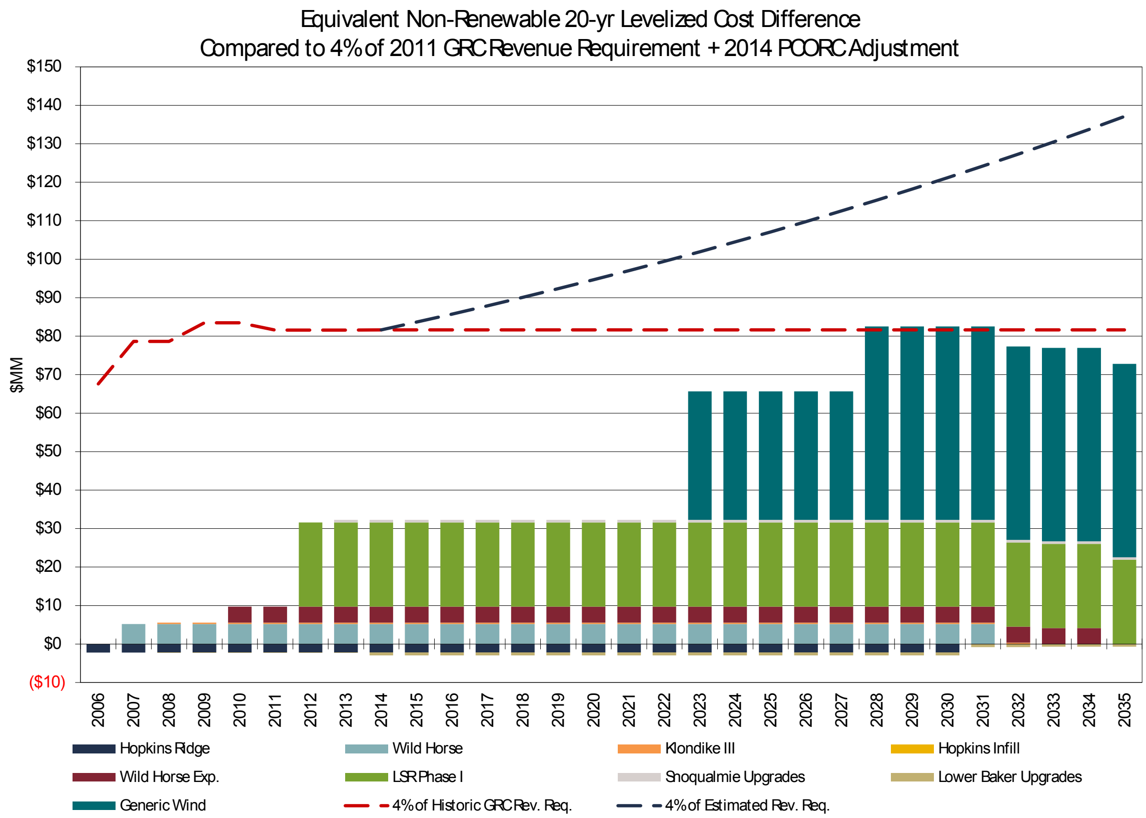
Figure N-50: 20-yr Incremental Cost of Wild Horse

($ Millions)	20-yr NPV
Wild Horse	375
Peaker	34
Market	285
20-yr Incremental Cost of Wild Horse	56

We chose to spread the incremental cost over 25 years since that is the depreciable life of a wind project used by PSE. The payment of $56 Million over 25 years comes to $5.2 Million/Year using the 7.01 percent discount rate.

Summary Results. Each renewable resource that counts towards meeting the renewable energy target was compared to an equivalent non-renewable resource starting in the same year and levelized over the book life of the plant: 25 years for wind power and 40 years for hydroelectric power. Figure N-51 presents results of this analysis for existing resources and projected resources. This demonstrates PSE expects to meet the physical targets under RCW 19.285 without being constrained by the cost cap. A negative cost difference means that the renewable was lower-cost than the equivalent non-renewable, while a positive cost means that the renewable was a higher cost.

Figure N-51: Equivalent Non-renewable 20-year Levelized Cost Difference Compared to 4% of 2011 GRC Revenue Requirement + 2014 PCORC adjustment



As the chart reveals, even if the company's revenue requirement were to stay the same for the next 10 years, PSE would still not hit the 4 percent requirement. The estimated revenue requirement uses a 2.5 percent assumed escalation from the company's current revenue requirement.

GAS ANALYSIS

Contents

This appendix presents details of the methods and model employed in PSE's gas sales resource analysis, and the data produced by that analysis.

ANALYTICAL MODEL

To model gas resources and alternatives for both long-term planning and gas resource acquisition activities, PSE uses a gas portfolio model (GPM). The GPM used in this IRP is SENDOUT® from ABB, a widely used software tool that helps identify the long-term least-cost combination of resources to meet stated loads. Other regional utilities that provide natural gas services, such as Avista, Cascade Natural Gas, and FortisBC, use the SENDOUT model. SENDOUT Version 14.2.0 was used for this analysis.

SENDOUT

SENDOUT is an integrated tool set for gas resource analysis that models the gas supply network and the portfolio of supply, storage, transportation and demand-side resources (DSR) to meet demand requirements.

SENDOUT can operate in two modes: For a defined planning period, it can determine the optimal set of resources to minimize costs; or, for a defined portfolio, it can determine the least-cost dispatch to meet demand requirements for that portfolio. SENDOUT solves both problems using a linear program (LP) to determine how a portfolio of resources (energy efficiency, supply, storage and transport), including associated costs and contractual or physical constraints, should be added and dispatched to meet demand in a least-cost fashion. The linear program considers thousands of variables and evaluates tens of thousands of possible solutions in order to generate a solution. A standard planning-period dispatch considers the capacity level of all resources as given, and therefore performs a variable-cost dispatch. A resource-mix dispatch can look at a range of potential capacity and size resources, including their fixed and variable costs.

Demand-side Resources (Energy Efficiency). SENDOUT provides a comprehensive set of inputs to model a variety of energy efficiency programs. Costs can be modeled at an overall program level or broken down into a variety of detailed accounts. The impact of efficiency programs on load can be modeled at the same detail level as demand. SENDOUT has the ability to determine the most cost-effective size of energy efficiency programs on an integrated basis with supply-side alternatives in a long-run resource mix analysis.

Gas Supply. SENDOUT allows a system to be supplied by either long-term gas contracts or short-term spot market purchases. Specific physical and contractual constraints can be modeled on a daily, monthly, seasonal or annual basis, such as maximum flow levels and minimum flow percentages. SENDOUT uses standard gas contract costs; the rates may be changed on a monthly or daily basis.

Storage. SENDOUT allows storage sources (either leased or company-owned) to serve the system. Storage input data include the minimum or maximum inventory levels, minimum or maximum injection and withdrawal rates, injection and withdrawal fuel loss, to and from interconnects, and the period of activity (i.e., when the gas is available for injection or withdrawal). There is also the option to define and name volume-dependent injection and withdrawal percentage tables (ratchets), which can be applied to one or more storage sources.

Transportation. SENDOUT provides the means to model transportation segments to define flows, costs and fuel loss. Flow values include minimum and maximum daily quantities available for sale to gas markets or for release. Cost values include standard fixed and variable transportation rates, as well as a per-unit cost generated for released capacity. Seasonal transportation contracts can also be modeled.

Demand. SENDOUT allows the user to define multiple demand areas and it can compute a demand forecast by class based on weather. The demand input is segregated into two components: 1) base load, which is not weather dependent, and 2) heat load, which is weather dependent. Both factors are further computed as a function of customer counts. The heat load factor is estimated by dividing the remaining non-base portion of the load by historical monthly average heating degree days (HDD) and monthly forecasted customer counts to derive energy per HDD per customer. The demand is input into SENDOUT on a monthly basis and includes the customer forecast, the baseload factors and the heat load factors computed over the entire 20-year demand forecast period.

As discussed, the gas system load is dependent on the weather pattern. The 2015 IRP used the most recent 30 years of data ending in 2014 to estimate the historical normal HDDs for each month. This monthly average HDD was then used to find an actual month that most closely matches this average. (Using an actual month produces a better distribution of daily temperatures for the representative month than simply using daily average temperatures.) In this way, months were selected to match the monthly average HDDs and a 12-month weather year was constructed for use in the IRP study. Finally, the gas analysis uses a design day peak standard of 52 HDD.[1] This design peak day demand value is manually inserted into the historical peak month, which is December for this 2015 IRP.

1 / The design day peak standard of 52 Heating Degree Days was established in PSE's 2005 IRP, Appendix I, Gas Planning Standard.

Resource Alternatives Assumptions

Figure O-1 summarizes resource costs and modeling assumptions for the pipeline alternatives considered in the IRP, and Figure O-2 summarizes resource costs and modeling assumptions for storage alternatives.

Figure O-1: Prospective Pipeline Alternatives Available

Alt No.	Alternative	From/To	Years Available beginning October	Maximum Capacity Available in Sendout (MDth per Day)	Capacity Demand ($ per Dth per Day)	Variable Commodity ($ per Dth per Day)	Fuel Use (%)	Comments
1A	Short Term NWP TF-1	Sumas to PSE	2016 - 2018	100	0.56	0.03	1.9	Potential available in marketplace from third parties from 2016-2018.
1	Westcoast + NWP Expansions	Station 2 to PSE	2018, 2022, 2026 and 2030	400 in 2018, 2022, 2026; 500 in 2030	0.52 + 0.56	0.01 + 0.03	1.6 + 1.9	Westcoast expansion coupled with NWP. Expansion expected to be available 2018 at the earliest.
2	FortisBC / Westcoast (KORP) + NWP Expansions	Kingsgate to PSE via Sumas	2018, 2022, 2026 and 2030	50 in 2018, 2022; 100 in 2026, 2030	0.42 + 0.56	0.01 + 0.03	1.0 + 1.4	Prospective projects & estimated project cost - expected to be available 2018 at the earliest. (Requires NGTL and Foothills pipelines.)
3	NGTL (Nova) Pipeline	AECO to Alberta / BC border	2018, 2022, 2026 and 2030	100 in 2018, 2022; 200 in 2026, 2030	0.16	0	0	Prospective projects & estimated project cost - expected to be available 2018 at the earliest.
3	Foothills Pipeline	Alberta / BC Border to Kingsgate	2018, 2022, 2026 and 2030	100 in 2018, 2022; 200 in 2026, 2030	0.097	0	1.0	Uncontracted capacity is available. (Requires NGTL.)
3	GTN Pipeline	Kingsgate to Stanfield	2018, 2022, 2026 and 2030	100	0.177	0.044	1.4	Uncontracted capacity is available. (Requires NGTL and Foothills pipelines.)
3 & 4	Cross Cascades	Stanfield to PSE	2018, 2022, 2026 and 2030	150	0.80	0.005	2.0	Prospective project & estimated project cost - expected available 2018 at the earliest. (Requires GTN Backhaul or NGTL/Foothills/GTN.)
4	Ruby Pipeline	Opal to Malin	2018,2022, 2026 and 2030	100	0.15	0	2.0	Published tariff is $1.14 but discounted rates are expected to be available for several years.
4	GTN "Backhaul"	Malin to Stanfield	2018,2022, 2026 and 2030	100	0.21	0.005	0	Uncontracted capacity is available.
6	Mist	Mist Storage to PSE	2018,2022, 2026 and 2030	50	0.56	.03	1.9	Expansion on NWP for delivery of gas from Mist Storage

Figure O-2: Prospective Storage Alternatives Available

Alt No.	Alternative	Location	Years Storage Capacity Estimated to be Available	Storage Capacity (MDth)	Maximum Withdrawal Capacity (MDth per day)	Days of Full Withdrawal (days)	Max. Injection Capacity (MDth per day)	Comments
5	PSE LNG Project (PSE portion) (1)	PSE System	winter 2018-19	538	66	8.2	2	Prospective confidential project, estimated size and costs
5	LNG Peak Gas Supply	PSE System	winter 2020-21	-	19	-	-	Only available with PSE LNG Project
6	Mist Expansion (1)	Portland, OR	winter 2018-19	1000	50	20	22.5	PSE to lease storage capacity from NW Natural after an expansion of the Mist storage facility
7	Swarr	PSE System	Winter 2016-2017	90	30	3	-	Existing plant requiring upgrades

NOTE
1 Prospective confidential project, estimated size and costs.

Scenarios and Sensitivities Analyzed

Ten scenarios were analyzed for the gas sales portfolio using the SENDOUT model. The assumptions used to create those scenarios are described in detail in Chapter 4, Key Analytical Assumptions, and summarized briefly below in Figure O-3.

Figure O-3: 2015 IRP Scenarios

	Scenario Name	Gas Price	CO_2 Price	Demand
1	Low Scenario	Low	None	Low
2	Base Scenario	Mid	Mid	Mid
3	High Scenario	High	High	High
4	Base + Low Gas Price	Low	Mid	Mid
5	Base + High Gas Price	High	Mid	Mid
6	Base + Very High Gas Price	Very High	Mid	Mid
7	Base + No CO_2	Mid	None	Mid
8	Base + High CO_2	Mid	High	Mid
9	Base + Low Demand	Mid	Mid	Low
10	Base + High Demand	Mid	Mid	High

Two sensitivity analyses were also run through the SENDOUT model to isolate the effect a single resource has on the portfolio:

ALTERNATE DISCOUNT RATE. This sensitivity tests the cost-effective amount of DSR in the Base Scenario using an alternate discount rate to model the value of demand-side resources over time. It compares the use of PSE's assigned weighted average cost of capital of 7.77 percent with an alternate discount rate of 4.93 percent.

PIPELINE TIMING. This sensitivity tests whether smoothing out pipeline capacity expansion changes the lowest cost portfolio in the Base Scenario. Instead of being restricted to every four years, pipeline additions are allowed annually.

ANALYSIS RESULTS

The optimal portfolios of supply- and demand-side resources for each of the scenarios and sensitivities were identified using SENDOUT. The cumulative resources added in each of the gas sales scenarios for the winter periods 2018-19, 2022-23, 2026-27, 2030-31 and 2032-33 are shown in Figures O-4 through O-8. Graphs of the resource additions for each of the scenarios are shown in Figures O-9 thru O-18. Resource additions for the each of the two sensitivities are shown in Figures O-19 and O-20.

Figure O-4: Gas Sales Scenario Cumulative Resource Additions for 2018-19 (MDth/day)

Peak Day Capacity MDth/day (2018-19)	Base	Low	High	Base + Low Gas	Base + High Gas	Base + Very High Gas	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
NWP Additions + Westcoast	-	-	25	-	-	-	-	-	-	27
NWP + KORP	-	-	-	-	-	-	-	-	-	-
Cross Cascades - AECO	-	-	-	-	-	-	-	-	-	-
Cross Cascades - Malin	-	-	-	-	-	-	-	-	-	-
Swarr	30	16	30	30	30	30	30	30	13	30
PSE LNG Project	69	69	69	69	69	69	69	69	41	69
Mist	-	-	-	-	-	-	-	-	-	-
DSR (Incl. Std Bundle)	12	9	13	10	12	12	10	12	12	12
Total	111	94	137	109	111	111	109	111	66	138

Figure O-5: Gas Sales Scenario Cumulative Resource Additions for 2022-23 (MDth/day)

Peak Day Capacity MDth/day (2022-23)	Base	Low	High	Base + Low Gas	Base + High Gas	Base + V High Gas	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
NWP Additions + Westcoast	34	-	77	28	-	32	44	32	19	89
NWP + KORP	-	-	-	-	-	-	-	-	-	-
Cross Cascades - AECO	-	-	-	-	9	-	-	-	-	-
Cross Cascades - Malin	-	-	-	-	-	-	-	-	-	-
Swarr	30	30	30	30	30	30	30	30	30	30
PSE LNG Project	85	73	85	69	85	85	84	85	41	85
Mist	-	-	13	31	23	-	-	-	-	4
DSR (Incl. Std Bundle)	29	20	32	25	30	30	23	30	29	29
Total	178	123	237	183	177	177	181	177	119	237

Figure O-6: Gas Sales Scenario Cumulative Resource Additions for 2026-27 (MDth/day)

Peak Day Capacity MDth/day (2026-27)	Base	Low	High	Base + Low Gas	Base + High Gas	Base + V High Gas	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
NWP Additions + Westcoast	49	53	77	85	-	48	58	47	27	102
NWP + KORP	-	-	-	-	-	-	-	-	-	-
Cross Cascades - AECO	10	-	9	-	9	9	9	9	9	9
Cross Cascades - Malin	-	-	50	-	49	-	5	-	-	27
Swarr	30	30	30	30	30	30	30	30	30	30
PSE LNG Project	85	73	85	69	85	85	84	85	41	85
Mist	50	19	50	50	50	50	50	50	50	50
DSR (Incl. Std Bundle)	46	32	50	39	48	48	37	48	46	46
Total	270	207	351	273	271	270	273	269	203	349

Figure O-7: Gas Sales Scenario Cumulative Resource Additions for 2030-31 (MDth/day)

Peak Day Capacity MDth/day (2030-31)	Base	Low	High	Base + Low Gas	Base + High Gas	Base + V High Gas	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
NWP Additions + Westcoast	102	165	240	184	-	100	117	105	90	216
NWP + KORP	-	-	-	-	100	-	-	-	-	-
Cross Cascades - AECO	10	10	9	9	59	9	9	9	9	9
Cross Cascades - Malin	99	-	71	45	49	100	100	95	58	100
Swarr	30	30	30	30	30	30	30	30	30	30
PSE LNG Project	85	73	85	69	85	85	84	85	41	85
Mist	50	19	50	50	50	50	50	50	50	50
DSR (Incl. Std Bundle)	58	41	62	49	60	60	46	60	58	58
Total	434	338	547	436	433	434	436	434	336	548

Figure O-8: Gas Sales Scenario Cumulative Resource Additions for 2034-35 (MDth/day)

Peak Day Capacity MDth/day (2034-35)	Base	Low	High	Base + Low Gas	Base + High Gas	Base + V High Gas	Base + No CO2	Base + High CO2	Base + Low Demand	Base + High Demand
NWP Additions + Westcoast	102	165	240	184	-	100	117	105	90	216
NWP + KORP	-	-	-	-	100	-	-	-	-	-
Cross Cascades - AECO	10	10	9	9	59	9	9	9	9	9
Cross Cascades - Malin	99	-	71	45	49	100	100	95	58	100
Swarr	30	30	30	30	30	30	30	30	30	30
PSE LNG Project	85	73	85	69	85	85	84	85	41	85
Mist	50	19	50	50	50	50	50	50	50	50
DSR (Incl. Std Bundle)	71	52	76	61	73	73	57	73	71	71
Total	447	349	561	448	446	447	447	447	349	561

Figure O-9: Base Scenario Optimal Portfolio – Gas Sales

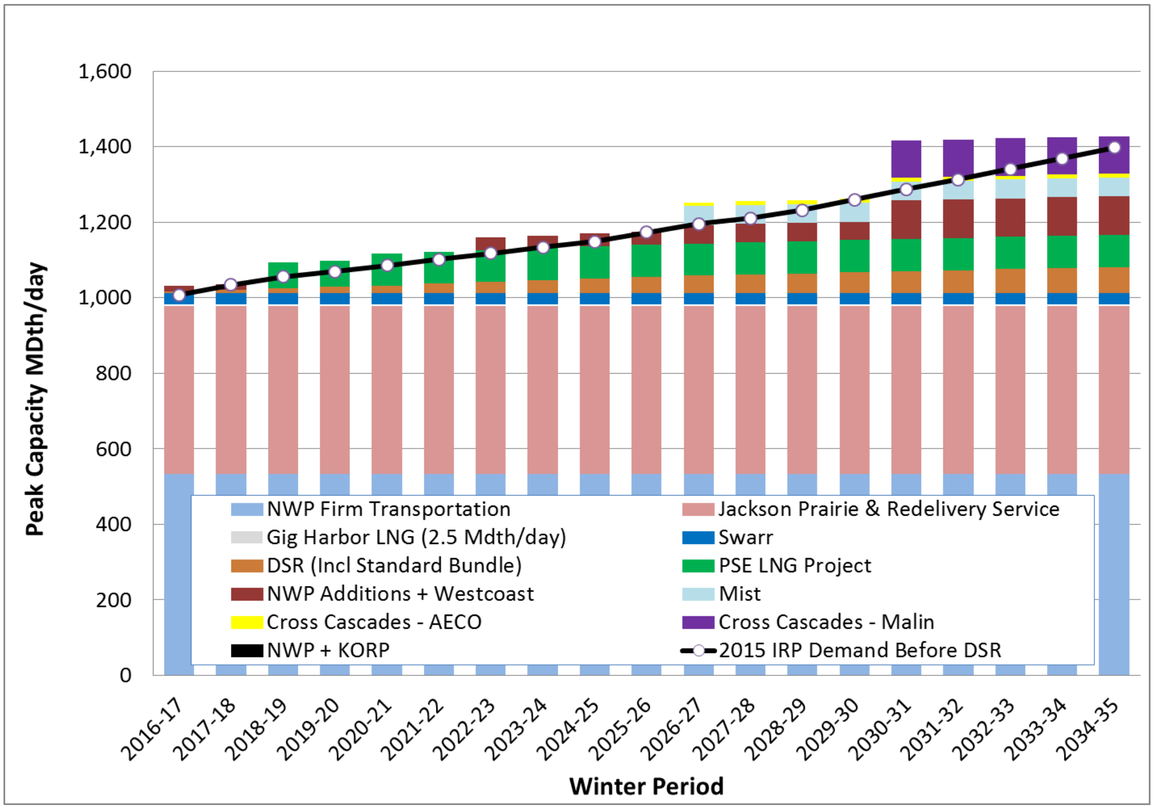


Figure O-10: Low Scenario Optimal Portfolio – Gas Sales

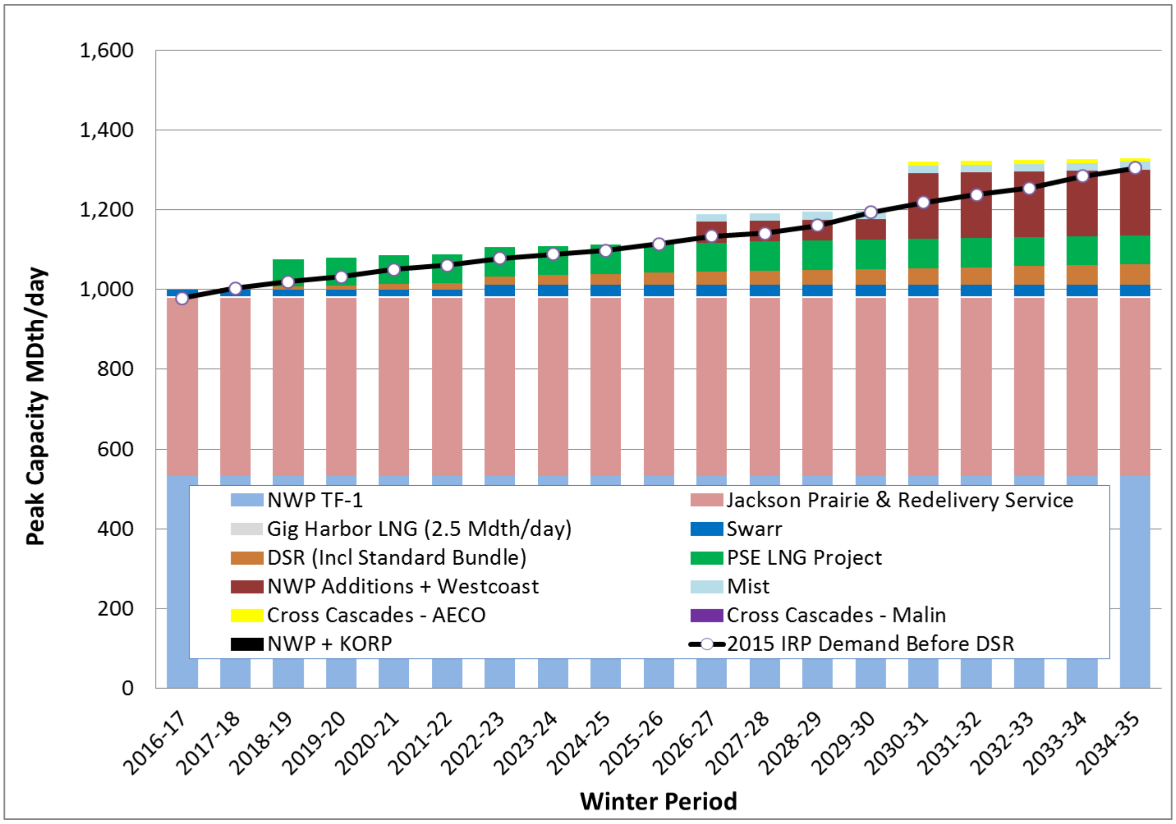


Figure O-11: High Scenario Optimal Portfolio – Gas Sales

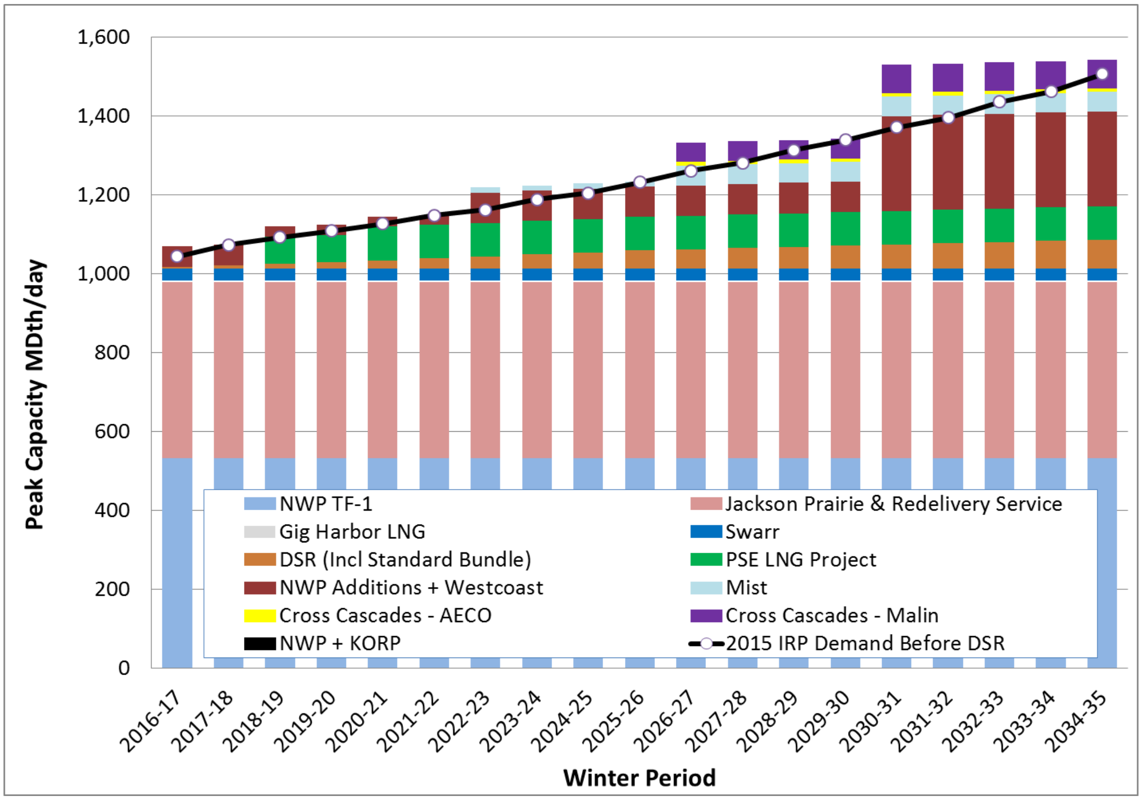


Figure O-12: Base + Low Gas Price Optimal Portfolio – Gas Sales

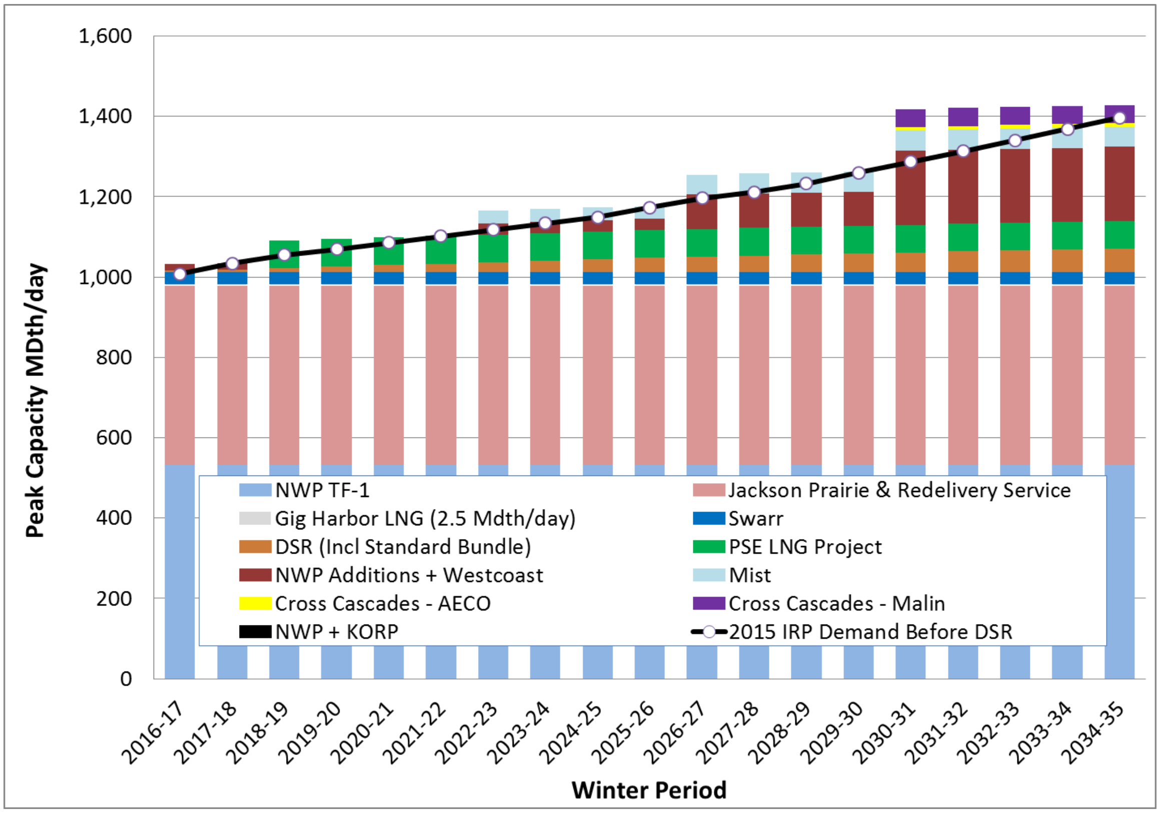


Figure O-13: Base + High Gas Price Scenario Optimal Portfolio – Gas Sales

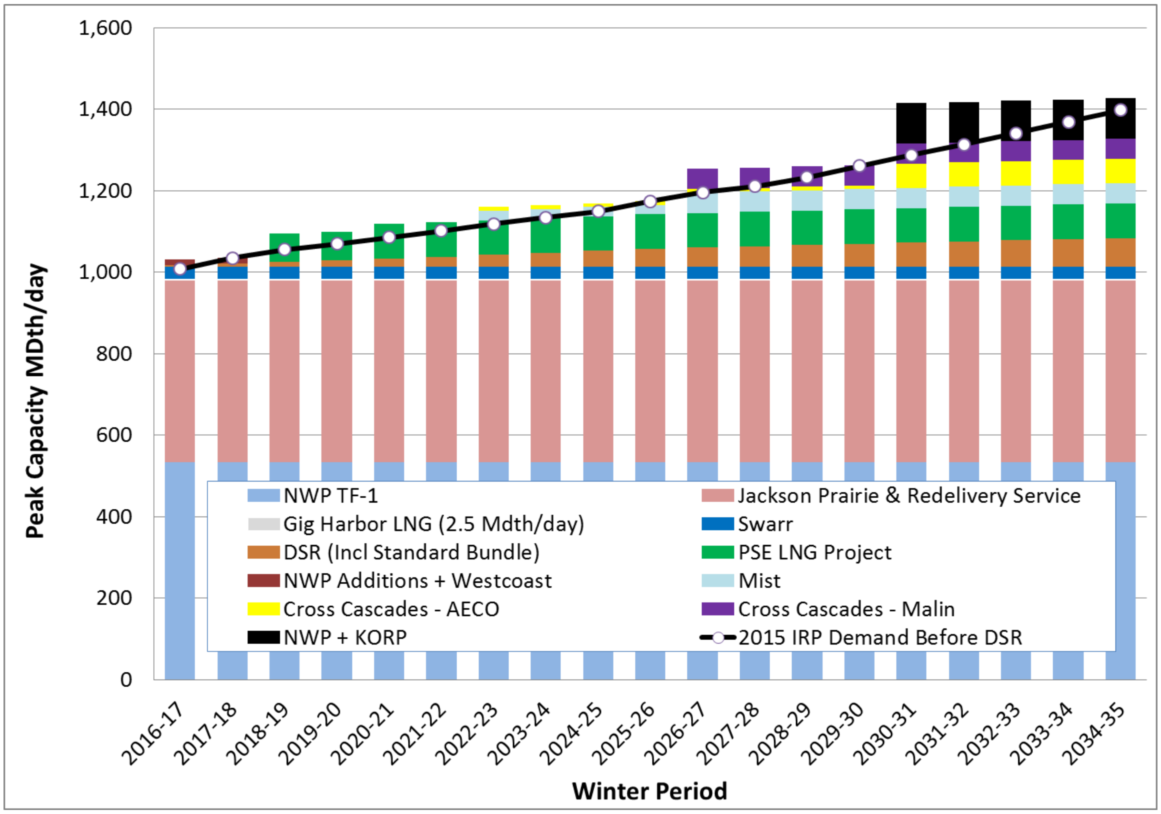


Figure O-14: Base + Very High Gas Price Optimal Portfolio – Gas Sales

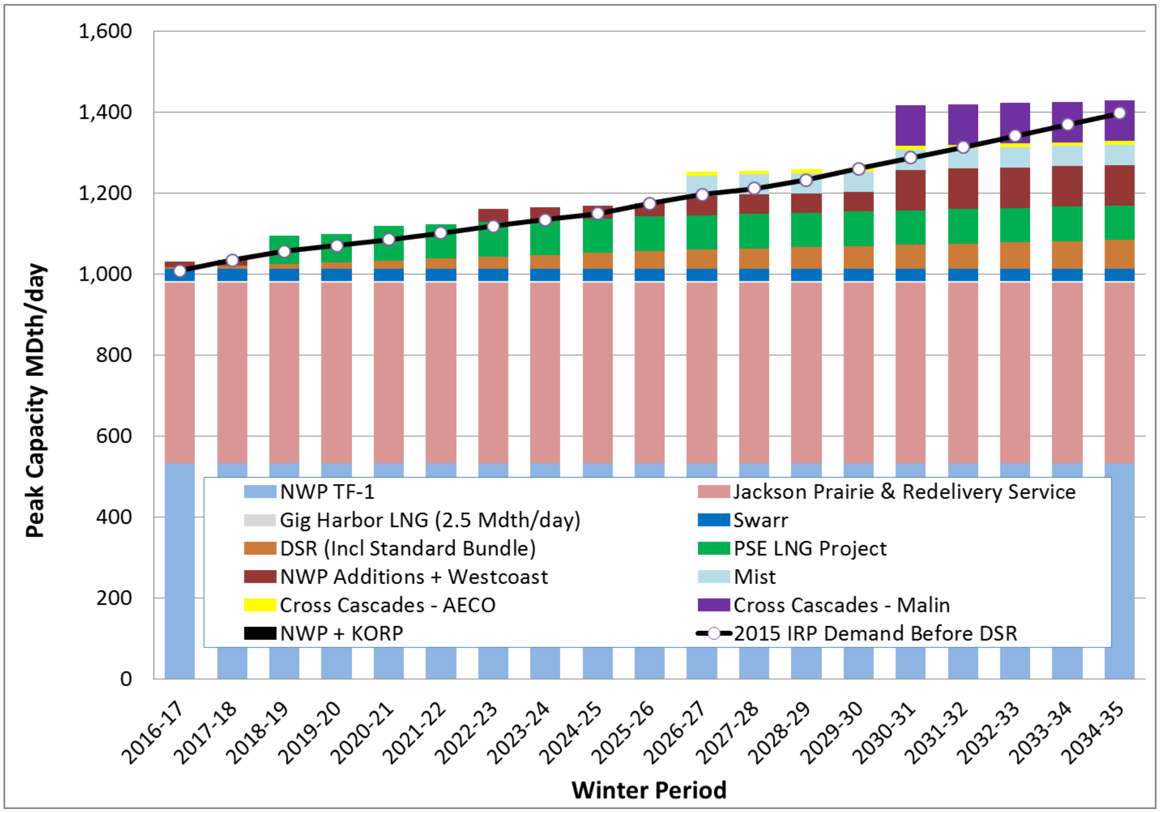


Figure O-15: Base + No CO_2 Optimal Portfolio – Gas Sales

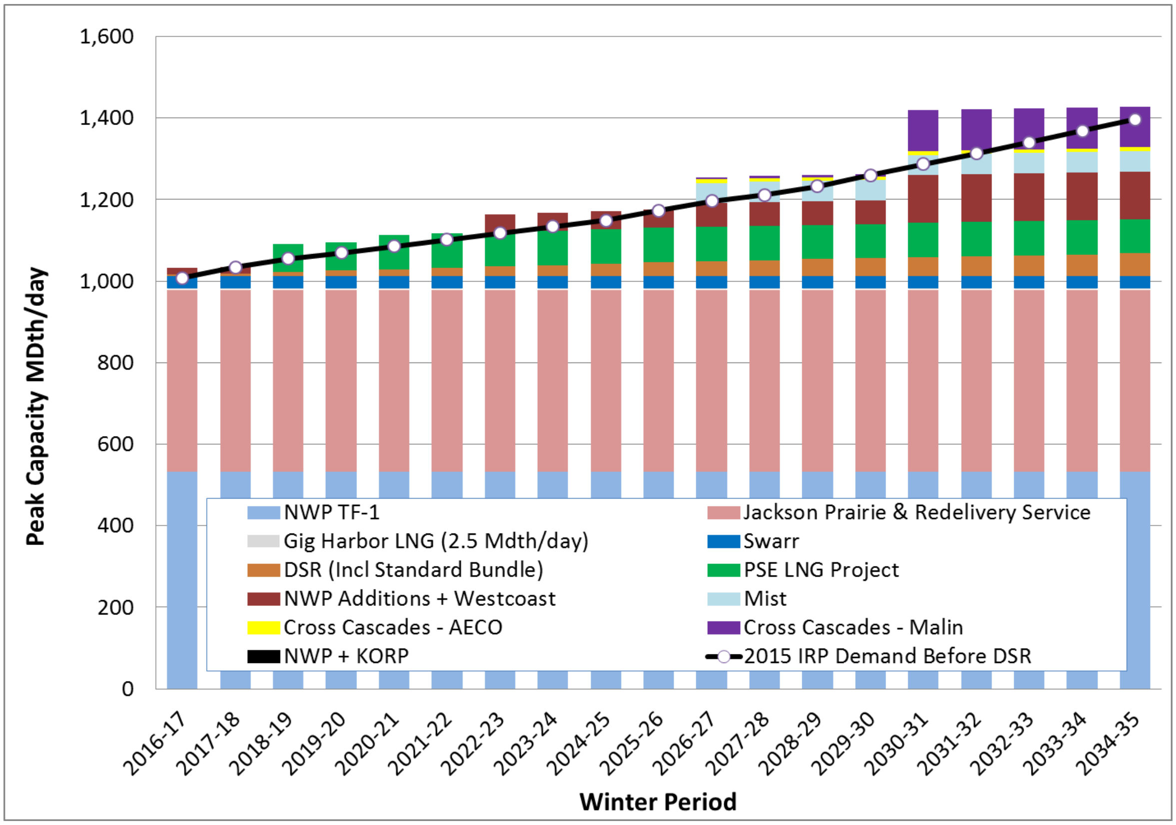


Figure O-16: Base + High CO_2 Optimal Portfolio – Gas Sales

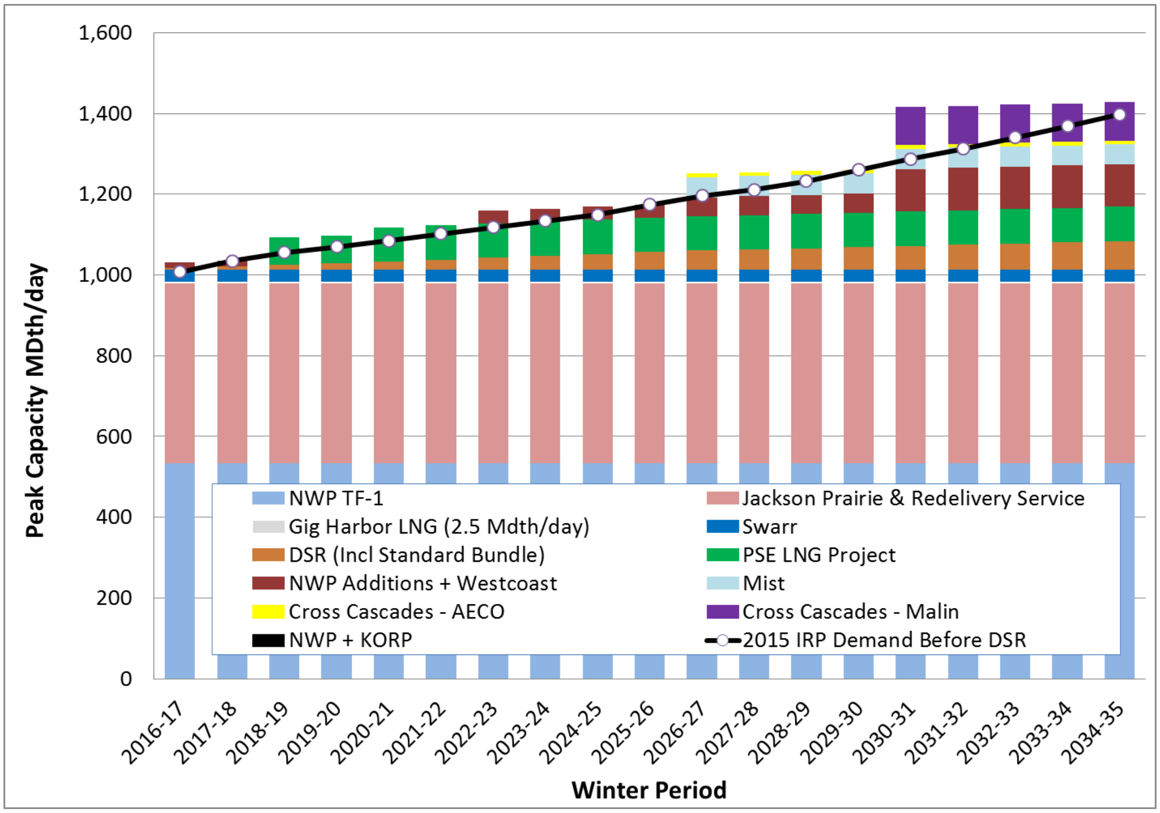


Figure O-17: Base + Low Demand Optimal Portfolio – Gas Sales

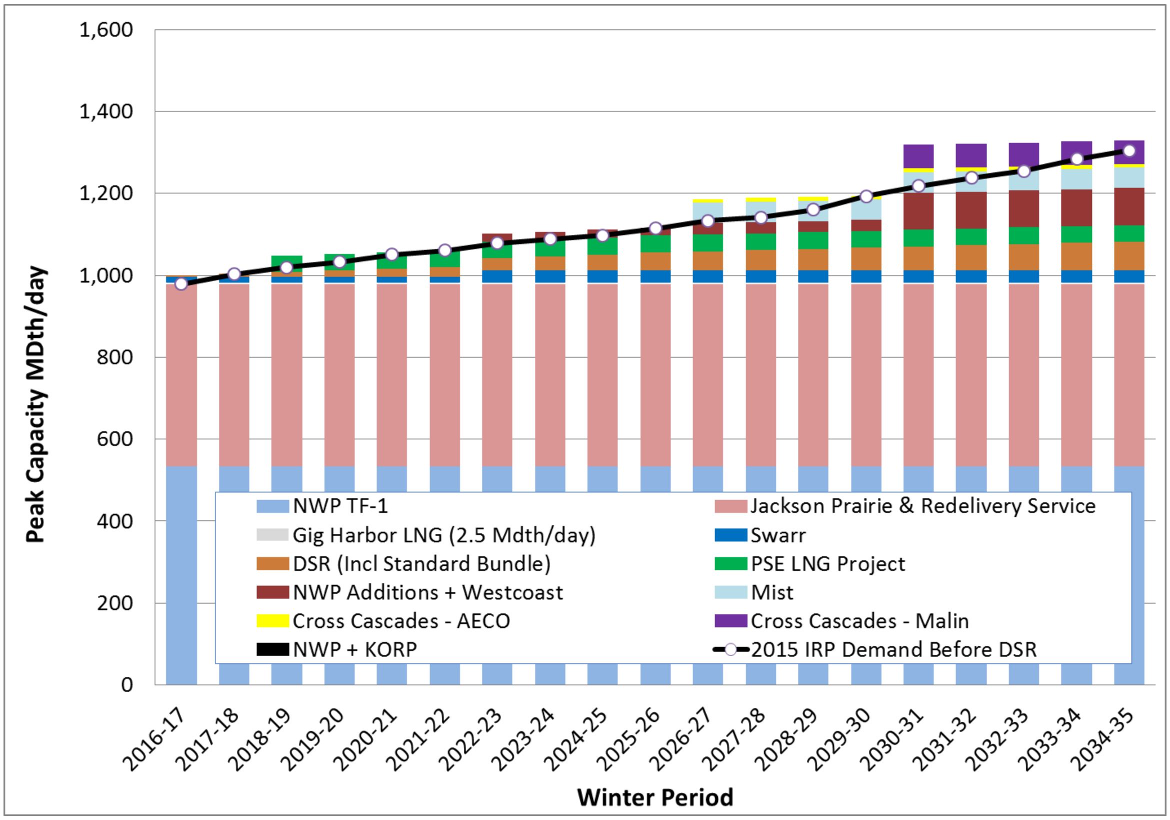


Figure O-18: Base + High Demand Optimal Portfolio – Gas Sales

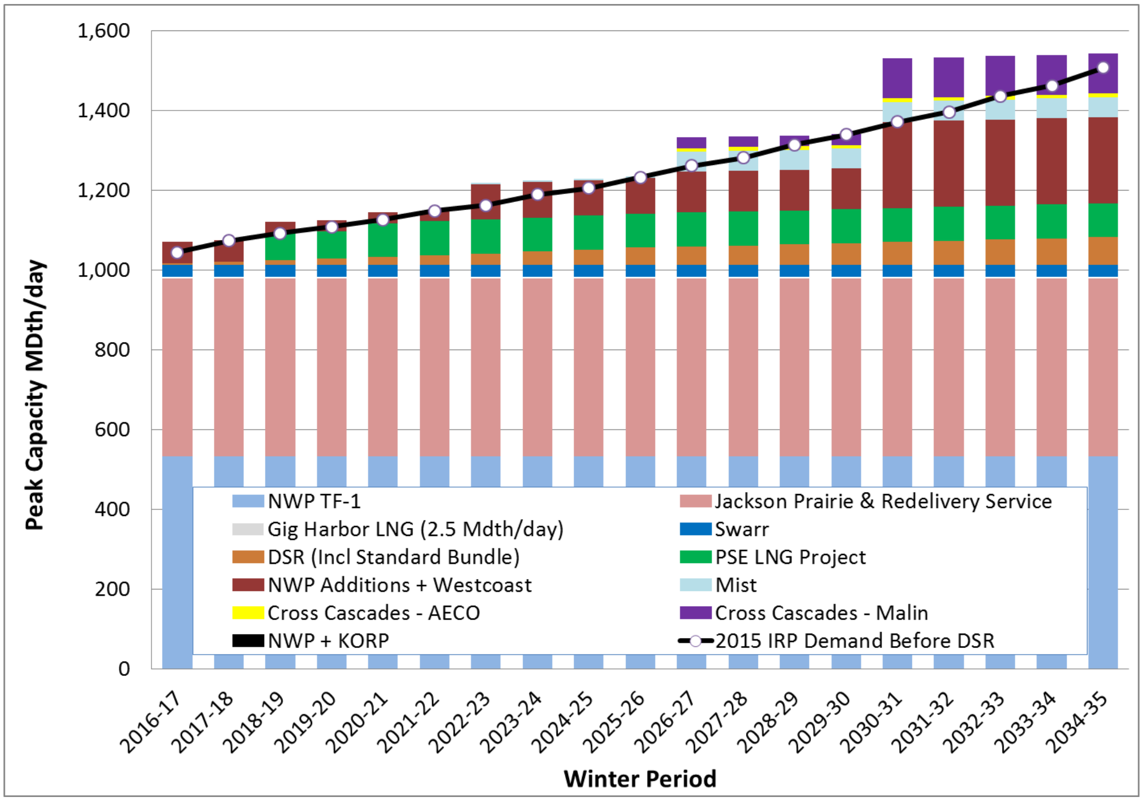


Figure O-19: Alternate Discount Rate Sensitivity
Gas Sales Cumulative Resource Additions (MDth/day)

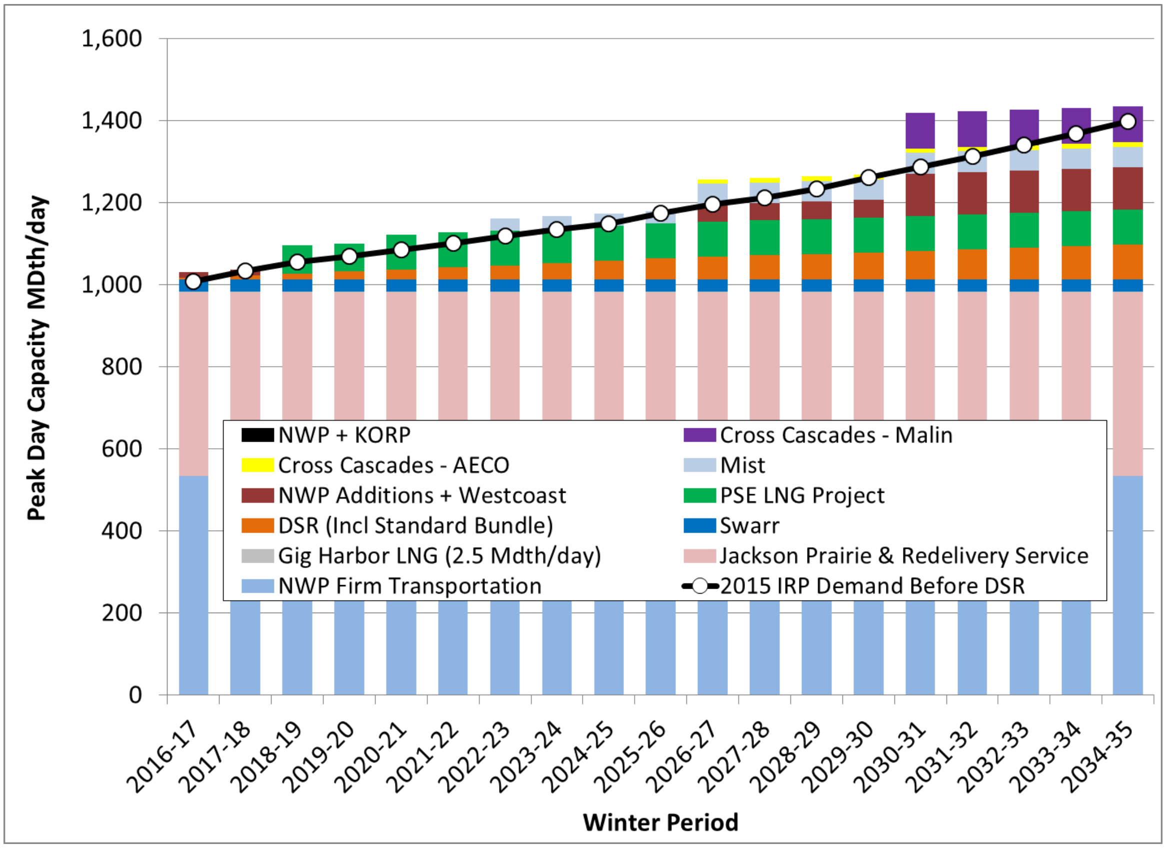
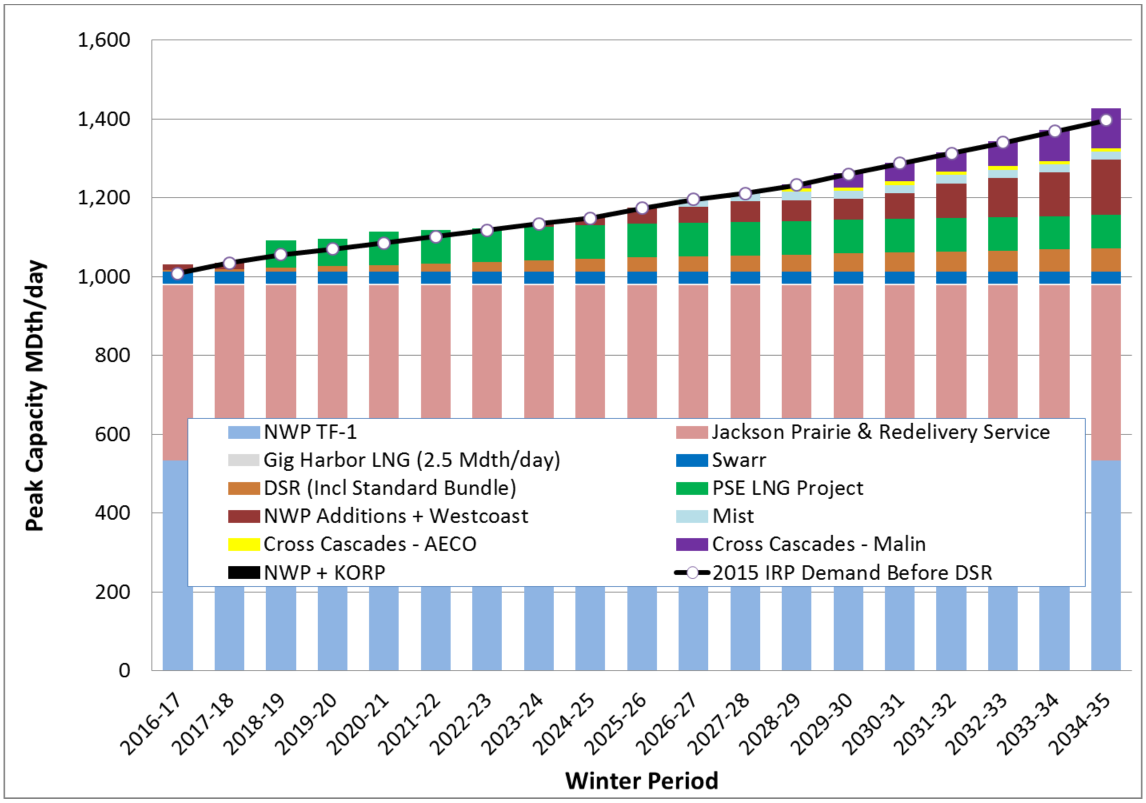


Figure O-20: Pipeline Timing Sensitivity

Gas Sales Cumulative Resource Additions (MDth/day)



PORTFOLIO DELIVERED GAS COSTS

The average delivered portfolio cost for the gas sales scenarios are shown graphically in Chapter 7. They are presented below in tabular form in Figure O-21. Note however, these costs represent the cost of gas delivered to PSE's system; they do not include distribution system costs.

Figure O-21: Portfolio Delivered Gas Costs - ($/Dth)

	Base	Low	High	Base+Low Gas	Base+High Gas	Base+V High Gas	Base+Zero CO2	Base+High CO2	Base+Low Demand	Base+High Demand
2016	$ 6.39	$ 4.96	$ 5.50	$ 5.84	$ 6.73	$ 7.29	$ 5.49	$ 5.55	$ 6.45	$ 6.34
2017	$ 6.55	$ 5.06	$ 5.96	$ 5.98	$ 7.21	$ 7.86	$ 5.59	$ 5.65	$ 6.58	$ 6.54
2018	$ 6.91	$ 5.23	$ 6.59	$ 6.27	$ 8.00	$ 8.33	$ 5.84	$ 5.90	$ 6.93	$ 6.82
2019	$ 6.95	$ 5.22	$ 7.23	$ 6.41	$ 8.40	$ 8.62	$ 5.89	$ 6.05	$ 6.90	$ 6.94
2020	$ 7.21	$ 5.40	$ 9.61	$ 6.46	$ 8.96	$ 9.13	$ 6.07	$ 8.02	$ 7.17	$ 7.21
2021	$ 7.50	$ 5.62	$ 10.17	$ 6.86	$ 9.21	$ 9.48	$ 6.27	$ 8.61	$ 7.45	$ 7.48
2022	$ 7.75	$ 5.76	$ 10.11	$ 7.20	$ 9.20	$ 9.73	$ 6.45	$ 8.95	$ 7.70	$ 7.75
2023	$ 8.19	$ 5.44	$ 10.62	$ 7.07	$ 9.38	$ 10.44	$ 6.80	$ 9.52	$ 8.10	$ 8.22
2024	$ 8.50	$ 5.87	$ 11.07	$ 7.71	$ 9.91	$ 10.86	$ 7.00	$ 9.97	$ 8.46	$ 8.50
2025	$ 8.94	$ 6.16	$ 11.99	$ 7.85	$ 10.32	$ 11.44	$ 7.35	$ 10.58	$ 8.87	$ 8.96
2026	$ 10.24	$ 6.55	$ 13.67	$ 8.45	$ 11.84	$ 12.78	$ 8.57	$ 12.02	$ 10.16	$ 10.28
2027	$ 10.58	$ 6.82	$ 13.94	$ 8.87	$ 12.02	$ 12.91	$ 8.79	$ 12.53	$ 10.51	$ 10.65
2028	$ 10.75	$ 6.94	$ 14.34	$ 9.11	$ 12.26	$ 13.58	$ 8.82	$ 13.04	$ 10.71	$ 10.82
2029	$ 11.47	$ 7.33	$ 15.04	$ 9.64	$ 12.71	$ 14.53	$ 9.28	$ 13.70	$ 11.36	$ 11.50
2030	$ 11.78	$ 7.38	$ 15.75	$ 9.91	$ 13.18	$ 15.54	$ 9.62	$ 14.39	$ 11.67	$ 11.87
2031	$ 12.42	$ 7.65	$ 16.53	$ 10.36	$ 14.14	$ 16.46	$ 10.16	$ 15.22	$ 12.23	$ 12.61
2032	$ 12.83	$ 7.81	$ 17.15	$ 10.67	$ 14.23	$ 17.31	$ 10.30	$ 15.96	$ 12.68	$ 12.92
2033	$ 13.18	$ 7.95	$ 17.98	$ 11.00	$ 14.77	$ 18.15	$ 10.46	$ 16.59	$ 13.04	$ 13.25
2034	$ 13.49	$ 8.13	$ 18.74	$ 11.32	$ 15.22	$ 19.02	$ 10.61	$ 17.27	$ 13.39	$ 13.51
2035	$ 13.83	$ 8.30	$ 19.36	$ 11.61	$ 15.33	$ 19.53	$ 10.74	$ 17.96	$ 13.78	$ 13.78