AEG

AVISTA ELECTRIC CONSERVATION POTENTIAL ASSESSMENT FOR 2022-2045

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1 | INTRODUCTION

In October 2021, Avista Corporation (Avista) engaged Applied Energy Group (AEG) to conduct a Conservation Potential Assessment (CPA) for its Washington and Idaho service areas. AEG first performed an electric CPA for Avista in 2013; since then, AEG has performed both electric and natural gas CPAs for Avista's planning cycles. The CPA is a 20-year study of electric and natural gas conservation potential, performed in accordance with Washington Initiative 937 and associated Washington Administrative Code provisions. This study provides data on conservation resources to support the development of Avista's 2022 Integrated Resource Plan (IRP). For reporting purposes, the potential results are separated by fuel. This report documents the electric CPA.

Notable updates from prior CPAs include:

- The analysis base year was brought forward from 2019 to 2021.
- For the residential sector, the study still incorporates Avista's GenPOP residential saturation survey from 2012, which provides a more localized look at Avista's customers than regional surveys. The survey provided the foundation for the base year market characterization and energy market profiles. The Northwest Energy Efficiency Alliance's (NEEA's) 2016 Residential Building Stock Assessment II (RBSA) supplemented the GenPOP survey to account for trends in the intervening years.
- The residential segmentation was expanded to include household counts and energy characteristics of low-income customers by dwelling type.
- For the commercial sector, the analysis was performed for the major building types in the service territory. Results from NEEA's 2019 Commercial Building Stock Assessment (CBSA), including hospital and university data, provided useful information for this analysis.
- The industrial segmentation was expanded to include a segment related to the pumping consumption.
- The list of energy conservation measures was updated with research from the Regional Technical Forum (RTF). In particular, light-emitting diode (LED) lamps continue to drop in price and provide a significant opportunity for savings, even accounting for RTF market transformation assumptions.
- Measure characterizations, which previously relied on data from the Northwest Power and Conservation Council's (NWPCC or Council) Seventh Power Plan, is now updated to the 2021 Power Plan, including measure data, adoption rates, and updated measure applicability.
- The study incorporates updated forecasting assumptions that align with the most recent Avista load forecast.

Enhancement retained from the previous CPA include:

- Analysis of economic potential was excluded from this study. Avista will screen for cost-effective opportunities directly within the IRP model. As such, economic potential and achievable potential have been replaced by a Achievable Technical Potential case.
- In addition to analyzing annual energy savings, the study also estimated the opportunity for reduction of summer and winter peak demand. This involved a full characterization by sector, segment, and end use of peak demand in the base year.

Summary of Report Contents

The report is divided into the following chapters, summarizing the approach, assumptions, and results of the electric CPA.

- **Chapter 2 – Energy Efficiency Analysis Approach and Data Development.** A detailed description of AEG's approach to estimating the energy efficiency potential and documentation of data sources used.

- **Chapter 3 – Energy Efficiency Market Characterization** presents how Avista's customers use electricity today and what equipment is currently being used.
- **Chapter 4 – Energy Efficiency Baseline Projection** presents the baseline end-use projections developed for each sector and state, as well as a summary.
- **Chapter 5 – Conservation Potential.** Energy efficiency potential results for each state across all sectors and separately for each sector.
- **Chapter 6 – Demand Response Potential.** Demand response potential results for each state across all sectors and separately for each sector.
- **Appendices A through D** provide backup detail on market profiles, market adoption (ramp) rates, measure data, and demand response.

There are three types of tables presented in the report to easily distinguish between the types of data presented. There is one type of table for each: general Avista data, Washington-specific data, and Idaho-specific data.

Abbreviations and Acronyms

Table 1-1 provides a list of abbreviations and acronyms used in this report, along with an explanation.

Table 1-1 Explanation of Abbreviations and Acronyms

Acronym	Explanation
A/C	Air Conditioning
AEG	Applied Energy Group
AEO	EIA's Annual Energy Outlook forecast
AMI	Advanced Metering Infrastructure
BEST	AEG's Building Energy Simulation Tool
BYOT	Bring Your Own Thermostat
C&I	Commercial and Industrial
CBSA	NEEA's Commercial Building Stock Assessment
CPA	Conservation Potential Assessment
DEER	California Database for Energy Efficient Resources
DEEM	AEG's Database of Energy Efficiency Measures
DLC	Direct Load Control
DR	Demand Response
DSM	Demand Side Management
EIA	U.S. Energy Information Administration
EPRI	Electric Power Research Institute
EUI	Energy Use Index
EVSE	Electric Vehicle Supply Equipment
HVAC	Heating Ventilation and Air Conditioning
IFSA	NEEA's Industrial Facilities Site Assessment
IRP	Integrated Resource Plan
LCOE	Levelized cost of energy
LED	Light Emitting Diode Lamp
LoadMAP	AEG's Load Management Analysis and Planning™ tool
MW	Megawatt
MWh	Megawatt Hour
NEEA	Northwest Energy Efficiency Alliance
NWPCC	Northwest Power and Conservation Council
O&M	Operations and Maintenance
PTR	Peak Time Rebate
RTF	NWPCC's Regional Technical Forum
RBSA	NEEA's Residential Building Stock Assessment
TOU	Time-of-Use
UEC	Unit Energy Consumption
VPP	Variable Peak Pricing

2 | ENERGY EFFICIENCY ANALYSIS APPROACH AND DATA DEVELOPMENT

This section describes the analysis approach taken and the data sources used to develop the energy efficiency potential estimates. The demand response analysis discussion can be found in Chapter 6.

Overview of Analysis Approach

To perform the potential analysis, AEG used a bottom-up approach following the major steps listed below. These steps are described in more detail throughout this section.

1. Perform a market characterization to describe sector-level electricity use for the residential, commercial, and industrial sectors for the base year 2021.
2. Develop a baseline projection of energy consumption and peak demand by sector, segment, and end use for 2021 through 2045.
3. Define and characterize several hundred conservation measures to be applied to all sectors, segments, and end uses.
4. Estimate Technical and Achievable Technical Potential at the measure level in terms of energy and peak demand impacts from conservation measures for 2023-2045.

LoadMAP Model

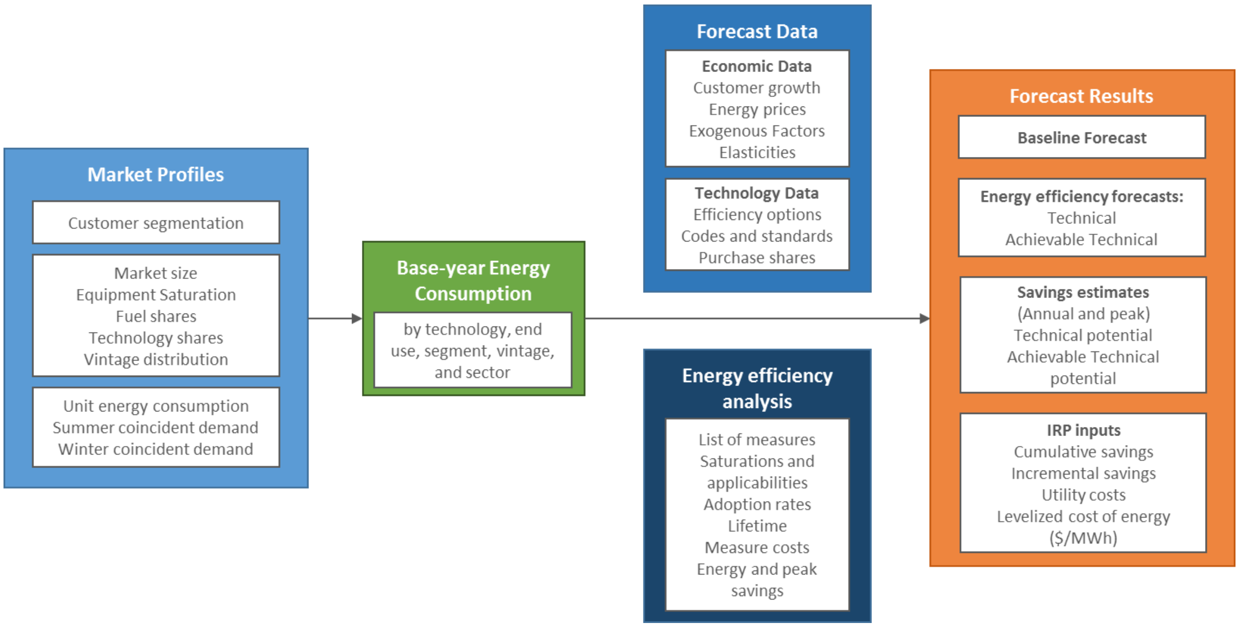
AEG used its Load Management Analysis and Planning tool (LoadMAP™) version 5.0 to develop both the baseline projection and the estimates of potential. AEG developed LoadMAP in 2007 and has enhanced it over time, using it for the Electric Power Research Institute (EPRI) National Potential Study and numerous utility-specific forecasting and potential studies since that time. Built in Excel, the LoadMAP framework (see Figure 2-1) is both accessible and transparent and has the following key features:

- Embodies the basic principles of rigorous end-use models (such as EPRI's REEPS and COMMEND) but in a more simplified, accessible form.
- Includes stock-accounting algorithms that treat older, less efficient appliance/equipment stock separately from newer, more efficient equipment. Equipment is replaced according to the measure life and appliance vintage distributions defined by the user.
- Balances the competing needs of simplicity and robustness. This is done by incorporating important modeling details related to equipment saturations, efficiencies, vintage, and the like, where market data are available, and treats end uses separately to account for varying importance and availability of data resources.
- Isolates new construction from existing equipment and buildings and treats purchase decisions for new construction and existing buildings separately.
- Uses a simple logic for appliance and equipment decisions. Other models available for this purpose embody complex decision-choice algorithms or diffusion assumptions. The model parameters tend to be difficult to estimate or observe, and sometimes produce anomalous results that require calibration or even overriding. The LoadMAP approach allows the user to drive the appliance and equipment choices year by year directly in the model. This flexible approach allows users to import the results from diffusion models or to input individual assumptions. The framework also facilitates sensitivity analysis.
- Includes appliance and equipment models customized by end use. For example, the logic for lighting is distinct from refrigerators and freezers.
- Can accommodate various levels of segmentation. Analysis can be performed at the sector level (e.g., total residential) or for customized segments within sectors (e.g., housing type or income level).

- Can incorporate conservation measures, demand-response options, combined heat and power, distributed generation options, and fuel switching.

Consistent with the segmentation scheme and market profiles described below, LoadMAP provides projections of baseline energy use by sector, segment, end use, and technology for existing and new buildings. It provides forecasts of total energy use and energy efficiency savings associated with the various types of potential.[1]

Figure 2-1 LoadMAP Analysis Framework



Definitions of Potential

AEG's approach for this study adheres to the approaches and conventions outlined in the National Action Plan for Energy Efficiency's Guide for Conducting Potential Studies[2] and is consistent with the methodology used by the Northwest Power and Conservation Council to develop its regional power plans. The guide represents the most credible and comprehensive industry practice for specifying conservation potential. Two types of potential were developed as part of this effort:

- **Technical Potential** is the theoretical upper limit of conservation potential. It assumes that customers adopt all feasible efficient measures regardless of their cost. At the time of existing equipment failure, customers replace their equipment with the most efficient option available. In new construction, customers and developers choose the efficient equipment option relative to applicable codes and standards. Non-equipment measures, which may be realistically installed apart from equipment replacements, are implemented according to ramp rates developed by the NWPCC for its 2021 Power Plan, applied to 100% of the applicable market. This case is provided primarily for planning and informational purposes.
- **Achievable Technical Potential** refines Technical Potential by applying market adoption rates that account for market barriers, customer awareness and attitudes, program maturity, and other factors that may affect market penetration of energy efficiency measures. AEG used achievability assumptions from the NWPCC's 2021 Power Plan, adjusted for Avista's recent program accomplishments, as the customer adoption rates for this study. For the achievable technical case, ramp rates are applied to between 85% - 100% of the

[1] The model computes energy and peak-demand forecasts for each type of potential for each end use as an intermediate calculation. Annual-energy and peak-demand savings are calculated as the difference between the value in the baseline projection and the value in the potential forecast (e.g., the technical potential forecast).

[2] National Action Plan for Energy Efficiency (2007). *National Action Plan for Energy Efficiency Vision for 2025: Developing a Framework for Change*. www.epa.gov/eeactionplan.

applicable market, per NWPCC methodology. This achievability factor represents potential that all available mechanisms, including utility programs, updated codes and standards, and market transformation, can reasonably acquire. Thus, the market applicability assumptions utilized in this study include savings outside of utility programs.[3] The market adoption factors can be found in Appendix B.

- Note that the previous CPA used ramp rates from the NWPCC's Seventh Power Plan, which assumed a fixed 85% achievability for all measures. In the 2021 Power Plan, some measures have this limit increased.

Market Characterization

To estimate the savings potential from energy efficient measures, it is necessary to understand how much energy is used today and what equipment is currently being used. The characterization begins with a segmentation of Avista's electricity footprint to quantify energy use by sector, segment, end-use application, and the current set of technologies used. To complete this step, AEG relied on information from Avista, NEEA, and secondary sources, as necessary.

Segmentation for Modeling Purposes

The market assessment first defined the market segments (building types, end uses, and other dimensions) that are relevant in the Avista service territory. The segmentation scheme for this project is presented in Table 2-1.

Table 2-1 Overview of Avista Analysis Segmentation Scheme

Dimension	Segmentation Variable	Description
1	Sector	Residential, commercial, industrial
2	Segment	Residential: single family, multifamily, manufactured home, differentiated by income level Commercial: small office, large office, restaurant, retail, grocery, college, school, health, lodging, warehouse, and miscellaneous Industrial: total
3	Vintage	Existing and new construction
4	End uses	Cooling, lighting, water heat, motors, etc. (as appropriate by sector)
5	Appliances/end uses and technologies	Technologies such as lamp type, air conditioning equipment, motors by application, etc.
6	Equipment efficiency levels for new purchases	Baseline and higher-efficiency options as appropriate for each technology

With the segmentation scheme defined, AEG then performed a high-level market characterization of electricity sales in the base year to allocate sales to each customer segment. AEG used Avista data and secondary sources to allocate energy use and customers to the various sectors and segments such that the total customer count, energy consumption, and peak demand matched the Avista system totals from 2021 billing data. This information provided control totals at a sector level for calibrating LoadMAP to known data for the base year.

Market Profiles

The next step was to develop market profiles for each sector, customer segment, end use, and technology. The market profiles provide the foundation for the development of the baseline projection and the potential estimates. A market profile includes the following elements:

- **Market size** is a representation of the number of customers in the segment. For the residential sector, it is the number of households. In the commercial sector, it is floor space measured in square feet. For the industrial sector, it is overall electricity use.

[3] Council's 7th Power Plan applicability assumptions reference an "Achievable Savings" report published August 1, 2007. http://www.nwcouncil.org/reports/2007/2007-13/

- **Saturations** define the fraction of homes or square feet with the various technologies (e.g., homes with electric space heating).
- **UEC (unit energy consumption) or EUI (energy use index)** describes the amount of energy consumed in 2021 by a specific technology in buildings that have the technology. UECs are expressed in kWh/household for the residential sector, and EUIs are expressed in kWh/square foot for the commercial sector.
- **Annual Energy Intensity** for the residential sector represents the average energy use for the technology across all homes in 2021 and is the product of the saturation and UEC. The commercial sector represents the average use for the technology across all floor space in 2021 and is the product of the saturation and EUI.
- **Annual Usage** is the annual energy use by an end-use technology in the segment. It is the product of the market size and intensity and is quantified in GWh.
- **Peak Demand** for each technology, summer peak and winter peak, is calculated using peak fractions of annual energy use from AEG's EnergyShape library and Avista system peak data.

The market characterization is presented in Chapter 3, and market profiles are presented in Appendix A.

Baseline Projection

The next step was to develop the baseline projection of annual electricity use and peak demand for 2021 through 2045 by customer segment and end use without new utility programs. The savings from past programs are embedded in the forecast, but the baseline projection assumes that those past programs cease to exist in the future. Possible savings from future programs are captured by the potential estimates. The projection includes the impacts of known codes and standards, which will unfold over the study timeframe. All such mandates that were defined as of July 2022 are included in the baseline.

The baseline projection is the foundation for the analysis of savings from future conservation efforts as well as the metric against which potential savings are measured. Although AEG's baseline projection aligns closely with Avista's, it is not Avista's official load forecast.

Inputs to the baseline projection include:

- Current economic growth forecasts (i.e., customer growth, income growth)
- Electricity price forecasts
- Trends in fuel shares and equipment saturations
- Existing and approved changes to building codes and equipment standards
- Avista's internally developed sector-level projections for electricity sales

AEG also developed a baseline projection for summer and winter peaks by applying peak fractions from the market profiles to the annual energy forecast in each year. The baseline projection is presented in Chapter 4.

Washington HB 1444

Washington's HB 1444 established energy efficiency standards around equipment that exceed federal standards. These energy efficiency measures include but are not limited to showerheads, aerators, commercial food service equipment, and office equipment. This study's foundational setup included assumptions of HB-1444's impact on the available market for energy efficiency measures in Washington.

Conservation Measure Analysis

This section describes the framework used to assess conservation measures' savings, costs, and other attributes. These characteristics form the basis for measure-level cost-effectiveness analyses and for determining measure savings. For all measures, AEG assembled information to reflect equipment performance, incremental costs, and equipment lifetimes. We used this information along with the 2021 Power Plan's updated ramp rates to identify achievable technical measure potential.

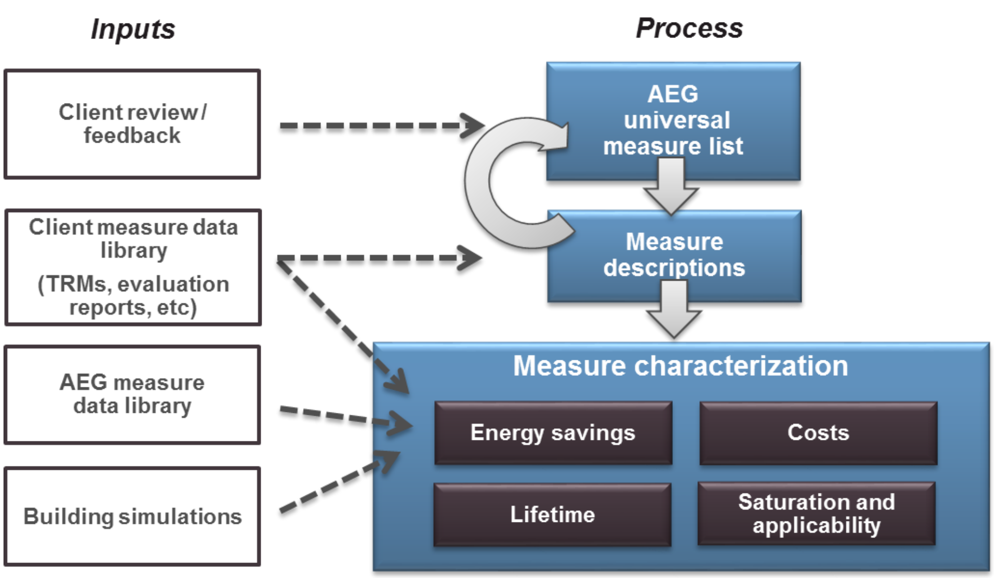
Conservation Measures

Figure 2-2 outlines the framework for conservation measure analysis. The framework involves identifying the list of measures to include in the analysis, determining their applicability to each sector and segment, fully characterizing each measure, and calculating the levelized cost of conserved energy (LCOE). Potential measures include the replacement of a unit that has failed or is at the end of its useful life with an efficient unit, retrofit, or early replacement of equipment, improvements to the building envelope, the application of controls to optimize energy use, and other actions resulting in improved energy efficiency.

AEG compiled a robust list of conservation measures for each customer sector, drawing upon Avista's measure database, the RTF, and the 2021 Power Plan deemed measures database, as well as a variety of secondary sources. This universal list of conservation measures covers all major types of end-use equipment, as well as devices and actions to reduce energy consumption.

Since an economic screen was not performed in this study, we calculated the LCOE for each measure evaluated. This value, expressed in dollars per first-year megawatt hour ($/MWh) saved, can be used by Avista's IRP model to evaluate measure economics. To calculate a measure's LCOE, first-year measure costs, annual non-energy impacts, and annual operations and maintenance (O&M) costs are levelized over a measure's lifetime, then divided by the first-year savings in MWh. Note that while non-energy benefits are typically included in the numerator of a traditional Total Resource Cost economic screen, the LCOE benefits have not been monetized. Therefore, these benefits are instead subtracted from the cost portion of the test. These non-energy benefits are not included in the Utility Cost Test used in Idaho.

Figure 2-2 Approach for Conservation Measure Assessment



The selected measures are categorized into the two following types according to the LoadMAP taxonomy:

- **Equipment measures** are efficient energy-consuming pieces of equipment that save energy by providing the same service with a lower energy requirement than a standard unit. An example is an ENERGY STAR refrigerator that replaces a standard efficiency refrigerator. For equipment measures, many efficiency levels may be available for a given technology, ranging from the baseline unit (often determined by code or standard) up to the most efficient product commercially available. For instance, in the case of central air conditioners, this list begins with the current federal standard SEER 13 unit and spans a broad spectrum up to a maximum efficiency of a SEER 24 unit. The 2021 Power Plan's "Lost Opportunity" ramp rates are primarily applied to equipment measures.

- **Non-equipment measures** save energy by reducing the need for delivered energy but do not involve replacement or purchase of major end-use equipment (such as a refrigerator or central air conditioner). An example would be a programmable thermostat that is pre-set to run heating and cooling systems only when people are home. Non-equipment measures can apply to more than one end use. For instance, the addition of wall insulation will affect the energy use of both space heating and cooling. The 2021 Power Plan's "Retrofit" ramp rates are primarily applied to no-equipment measures. Non-equipment measures typically fall into one of the following categories:
  - Building shell (windows, insulation, roofing material)
  - Equipment controls (thermostat, compressor staging, and controls)
  - Equipment maintenance (cleaning filters, changing setpoints)
  - Whole-building design (building orientation, advanced new construction designs)
  - Lighting retrofits (assumed to be implemented alongside new LEDs at the equipment's normal end of life)
  - Displacement measures (ceiling fan to reduce the use of central air conditioners)
  - Commissioning and retrocommissioning (initial or ongoing monitoring of building energy systems to optimize energy use)

We developed a preliminary list of conservation measures, which was distributed to the Avista project team for review. The list was finalized after incorporating comments. Next, the project team characterized measure savings, incremental cost, service life, and other performance factors, drawing upon data from the Avista measure database, the 2021 Power Plan, the RTF deemed measure workbooks, simulation modeling, and other well-vetted sources as required. Measure data can be found in Appendix C. Table 2-2 summarizes the number of measures evaluated for each segment within each sector.

Table 2-2 Number of Measures Evaluated

Sector	Total Measures	Measure Permutations w/ 2 Vintages	Measure Permutations w/ Segments
Residential	106	212	1,272
Commercial	140	280	3,080
Industrial	90	180	360
Total Measures Evaluated	**336**	**658**	**4,712**

Data Development

This section details the data sources used in this study, followed by a discussion of how these sources were applied. In general, data sources were applied in the following order: Avista data, Northwest regional data, and well-vetted national or other regional secondary sources.

Avista Data

Our highest priority data sources for this study were those that were specific to Avista.

- *Customer Data:* Avista provided billing data for the development of customer counts and energy use for each sector. We also used the results of the Avista GenPOP survey, a residential saturation survey.
- *Load Forecasts:* Avista provided an economic growth forecast by sector; electric load forecast; peak-demand forecasts at the sector level; and retail electricity price history and forecasts.

- *Economic Information:* Avista provided a discount rate and line loss factor. Avoided costs were not provided due to the economic screen being moved to the IRP model.
- *Program Data:* Avista provided information about past and current programs, including program descriptions, goals, and achievements to date.

Northwest Energy Efficiency Alliance Data

The NEEA conducts research for the Northwest region. The following studies were particularly useful:

- RBSA II, Single-Family Homes Report 2016-2017.
- RBSA II, Manufactured Homes Report 2016-2017.
- RBSA II, Multifamily Buildings Report 2016-2017.
- 2019 Commercial Building Stock Assessment (CBSA), May 21, 2020.
- 2014 Industrial Facilities Site Assessment (IFSA), December 29, 2014.

Northwest Power and Conservation Council Data

Several sources of data were used to characterize the conservation measures. We used the following regional data sources and supplemented them with AEG's data sources to fill in any gaps.

- RTF Deemed Measures. The NWPCC RTF maintains databases of deemed measure savings data.
- NWPCC 2021 Power Plan Conservation Supply Curve Workbooks. To develop its 2021 Power Plan, the Council used workbooks with detailed information about measures.
- NWPCC, MC and Loadshape File, September 29, 2016. The Council's load shape library was utilized to convert CPA results into hourly conservation impacts for use in Avista's IRP process.

AEG Data

AEG maintains several databases and modeling tools that we use for forecasting and potential studies. Relevant data from these tools have been incorporated into the analysis and deliverables for this study.

- **AEG Energy Market Profiles:** AEG maintains regional profiles of end-use consumption. The profiles include market size, fuel shares, unit consumption estimates, annual energy use by fuel (electricity and natural gas), customer segment, and end use for ten (10) regions in the U.S. The U.S. Energy Information Administration (EIA) surveys (RECS, CBECS, and MECS), as well as state-level statistics and local customer research provide the foundation for these regional profiles.
- **Building Energy Simulation Tool (BEST):** AEG's BEST is a derivative of the DOE 2.2 building simulation model, used to estimate base-year UECs and EUIs, as well as measure savings for the HVAC-related measures.
- **AEG's Database of Energy Efficiency Measures (DEEM):** AEG maintains an extensive database of measure data, drawing upon reliable sources, including the California Database for Energy Efficient Resources (DEER), the EIA Technology Forecast Updates – Residential and Commercial Building Technologies – Reference Case, RS Means cost data, and Grainger Catalog Cost data.
- **Recent studies:** AEG has conducted numerous studies of energy efficiency potential in the last five years. We checked our input assumptions and analysis results against the results from these other studies, which include but are not limited to Tacoma Power, Idaho Power, and PacifiCorp.

Other Secondary Data and Reports

Finally, a variety of secondary data sources and reports were used for this study. The main sources include:

- **Annual Energy Outlook (AEO):** Conducted each year by the U.S. EIA, the AEO presents yearly projections and analysis of energy topics. For this study, we used data from the 2021 AEO.

- **Local Weather Data:** Weather from National Oceanic and Atmospheric Administration's National Climatic Data Center for Spokane, Washington, was used as the basis for building simulations.
- **EPRI End-Use Models (REEPS and COMMEND):** These models provide the elasticities we apply to electricity prices, household income, home size, and heating and cooling.
- **DEER:** The California Energy Commission and California Public Utilities Commission sponsor this database, which is designed to provide well-documented estimates of energy and peak demand savings values, measure costs, and effective useful life for the state of California. We used the DEER database to cross-check the measure savings we developed using BEST and DEEM.
- **Other relevant regional sources:** These include reports from the Consortium for Energy Efficiency, the Environmental Protection Agency, and the American Council for an Energy-Efficient Economy.

Data Application

We now discuss how the data sources described above were used for each step of the study.

Data Application for Market Characterization

To construct the high-level market characterization of electricity use and households/floor space for each sector, we used Avista billing data and customer surveys to estimate energy use.

- **Residential Segments.** Avista estimated the number of customers and average energy use per customer for each segment based on its GenPOP survey matched to billing data for surveyed customers. AEG compared the resulting segmentation with data from the American Community Survey regarding housing types and income and found that the Avista segmentation corresponded well with the American Community Survey.
- **C&I Segments**. We relied upon the allocation from the previous CPA. For the previous study, customers and sales were allocated to building type based on SIC codes, with some adjustments between the C&I sectors to better group energy use by facility type and predominate end uses.

Data Application for Market Profiles

The specific data elements for the market profiles, together with the key data sources, are shown in Table 2-3. To develop the market profiles for each segment, AEG performed the following steps:

1. Developed control totals for each segment. These include market size, segment-level annual electricity use, and annual intensity.
2. Used the Avista GenPOP Survey; NEEA's RBSA, CBSA, and IFSA; and AEG's Energy Market Profiles database to develop existing appliance saturations, appliance and equipment characteristics, and building characteristics.
3. Ensured calibration to control totals for annual electricity sales in each sector and segment.
4. Compared and cross-checked with other recent AEG studies.
5. Worked with Avista staff to vet the data against their knowledge and experience.

Table 2-3 Data Applied for the Market Profiles

Model Inputs	Description	Key Sources
Market size	Base-year residential dwellings, commercial floor space, and industrial employment	Avista billing data Avista GenPOP Survey NEEA RBSA and CBSA AEO 2019
Annual intensity	Residential: Annual use per household Commercial: Annual use per square foot Industrial: Annual use per employee	Avista billing data AEG's Energy Market Profiles NEEA RBSA and CBSA AEO 2019 Other recent studies
Appliance/equipment saturations	Fraction of dwellings with an appliance/technology Percentage of C&I floor space/employment with equipment/technology	Avista GenPOP Survey NEEA RBSA and CBSA AEG's Energy Market Profiles
UEC/EUI for each end-use technology	UEC: Annual electricity use in homes and buildings that have the technology EUI: Annual electricity use per square foot/employee for a technology in floor space that has the technology	NWPCC RTF and 2021 Power Plan and RTF HVAC uses: BEST simulations using prototypes developed for Idaho Engineering analysis DEEM Recent AEG studies
Appliance/equipment age distribution	Age distribution for each technology	RTF and NWPCC Seventh Power Plan data NEEA regional survey data Utility saturation surveys Recent AEG studies
Efficiency options for each technology	List of available efficiency options and annual energy use for each technology	AEG DEEM AEO 2019 DEER RTF and NWPCC 2021 Plan data Previous studies
Peak factors	Share of technology energy use that occurs during the peak hour	EnergyShape database

Data Application for Baseline Projection

Table 2-4 summarizes the LoadMAP model inputs required for the baseline projection. These inputs are required for each segment within each sector, as well as for new construction and existing dwellings/buildings.

Table 2-4 Data Needs for the Baseline Projection and Potentials Estimation in LoadMAP

Model Inputs	Description	Key Sources
Customer growth forecasts	Forecasts of new construction in residential, commercial, and industrial sectors	Avista load forecast AEO 2021 economic growth forecast
Equipment purchase shares for baseline projection	For each equipment/technology, purchase shares for each efficiency level; specified separately for existing equipment replacement and new construction	Shipments data from AEO and ENERGY STAR AEO 2021 regional forecast assumptions[4] Appliance/efficiency standards analysis Avista program results and evaluation reports
Utilization model parameters	Price elasticities, elasticities for other variables (income, weather)	EPRI's REEPS and COMMEND models AEO 2021

[4] We developed baseline purchase decisions using the EIA's *Annual Energy Outlook* report (2016), which utilizes the National Energy Modeling System to produce a self-consistent supply and demand economic model. We calibrated equipment purchase options to match manufacturer shipment data for recent years and then held values constant for the study period. This removes any effects of naturally occurring conservation or effects of future energy efficiency programs that may be embedded in the AEO forecasts.

AEG incorporated known future equipment standards as of May 2022, as shown in Table 2-5 and Table 2-6. The assumptions tables here extend through 2025, after which all standards are assumed to hold steady.

Table 2-5 Residential Electric Equipment Standards

<table>
<tr><th>End Use</th><th>Technology</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th></tr>
<tr><td rowspan="2">Cooling</td><td>Central AC</td><td colspan="2">SEER 13.0</td><td colspan="3">SEER 14.0</td></tr>
<tr><td>Room AC</td><td colspan="5">EER 10.8</td></tr>
<tr><td>Cool/Heating</td><td>Air-Source Heat Pump</td><td colspan="2">SEER 14.0 / HSPF 8.2</td><td colspan="3">SEER 15.0 / HSPF 8.8</td></tr>
<tr><td rowspan="2">Water Heating</td><td>Water Heater (≤55 gallons)</td><td colspan="5">EF 0.95</td></tr>
<tr><td>Water Heater (>55 gallons)</td><td colspan="5">EF 2.0 (Heat Pump Water Heater)</td></tr>
<tr><td rowspan="2">Lighting</td><td>General Service</td><td colspan="5">Federal Backstop (45 lm/w lamp)</td></tr>
<tr><td>Linear Fluorescent</td><td colspan="5">T8 (92.5 lm/W lamp)</td></tr>
<tr><td rowspan="3">Appliances</td><td>Refrigerator & Freezer</td><td colspan="5">25% more efficient than the 1997 Final Rule (62 FR 23102)</td></tr>
<tr><td>Clothes Washer</td><td colspan="5">IMEF 1.84 / WF 4.7</td></tr>
<tr><td>Clothes Dryer</td><td colspan="5">3.73 Combined EF</td></tr>
<tr><td>Miscellaneous</td><td>Furnace Fans</td><td colspan="5">ECM</td></tr>
</table>

Table 2-6 Commercial and Industrial Electric Equipment Standards

<table>
<tr><th>End Use</th><th>Technology</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th></tr>
<tr><td rowspan="3">Cooling</td><td>Chillers</td><td colspan="5">2007 ASHRAE 90.1</td></tr>
<tr><td>Roof Top Units</td><td colspan="5">2007 ASHRAE 90.1</td></tr>
<tr><td>PTAC</td><td colspan="5">EER 11.9</td></tr>
<tr><td rowspan="2">Cool/Heating</td><td>Heat Pump</td><td colspan="5">EER 11.3/COP 3.3</td></tr>
<tr><td>PTHP</td><td colspan="5">EER 11.9/COP 3.3</td></tr>
<tr><td>Ventilation</td><td>All</td><td colspan="5">Constant Air Volume/Variable Air Volume</td></tr>
<tr><td rowspan="3">Lighting</td><td>General Service</td><td colspan="5">Federal Backstop (45 lm/w lamp)</td></tr>
<tr><td>Linear Lighting</td><td colspan="5">T8 (92.5 lm/W lamp)</td></tr>
<tr><td>High Bay</td><td colspan="5">High-Efficiency Ballast</td></tr>
<tr><td rowspan="5">Refrigeration</td><td>Walk-In</td><td colspan="5">24% more efficient than 2017</td></tr>
<tr><td>Reach-In</td><td colspan="5">40% more efficient</td></tr>
<tr><td>Glass Door</td><td colspan="5">12-28% more efficient</td></tr>
<tr><td>Open Display</td><td colspan="5">10-20% more efficient</td></tr>
<tr><td>Icemaker</td><td colspan="5">15% more efficient</td></tr>
<tr><td>Food Service</td><td>Pre-Rinse</td><td colspan="5">1.0 GPM</td></tr>
<tr><td>Motors</td><td>All</td><td colspan="5">Expanded EISA 2007</td></tr>
</table>

Conservation Measure Data Application

Table *2-7* details the energy efficiency data inputs to the LoadMAP model, describes each input, and identifies the key sources used in the Avista analysis.

Table 2-7 Data Needs for the Measure Characteristics in LoadMAP

Model Inputs	Description	Key Sources
Energy Impacts	The annual reduction in consumption attributable to each specific measure. Savings were developed as a percentage of the energy end use that the measure affects.	Avista measure data NWPCC workbooks, RTF NWPCC 2021 Plan conservation workbooks BEST AEG DEEM AEO 2021 DEER Other secondary sources
Peak Demand Impacts	Savings during the peak demand periods are specified for each electric measure. These impacts relate to the energy savings and depend on the extent to which each measure is coincident with the system peak.	Avista measure data BEST AEG DEEM EnergyShape
Costs	Equipment Measures: Includes the full cost of purchasing and installing the equipment on a per-household, per-square-foot, per employee or per service point basis for the residential, commercial, and industrial sectors, respectively. Non-equipment measures: Existing buildings – full installed cost. New Construction - the costs may be either the full cost of the measure, or as appropriate, it may be the incremental cost of upgrading from a standard level to a higher efficiency level.	Avista measure data NWPCC workbooks, RTF NWPCC 2021 Plan conservation workbooks AEG DEEM AEO 2021 DEER RS Means Other secondary sources
Measure Lifetimes	Estimates derived from the technical data and secondary data sources that support the measure demand and energy savings analysis.	Avista measure data NWPCC workbooks, RTF NWPCC 2021 Plan conservation workbooks AEG DEEM AEO 2021 DEER Other secondary sources
Applicability	Estimate of the percentage of dwellings in the residential sector, square feet in the commercial sector, or employees in the industrial sector where the measure is applicable and where it is technically feasible to implement.	Avista measure data NWPCC workbooks, RTF NWPCC 2021 Plan conservation workbooks AEG DEEM DEER Other secondary sources
On Market and Off Market Availability	Expressed as years for equipment measures to reflect when the equipment technology is available or no longer available in the market.	AEG appliance standards and building codes analysis

Data Application for Achievable Technical Potential

To estimate Achievable Technical Potential, two sets of parameters are needed to represent customer decision-making behavior with respect to energy-efficiency choices.

- **Technical diffusion curves for non-equipment measures.** Equipment measures are installed when existing units fail. Non-equipment measures do not have this natural periodicity, so rather than installing all available non-equipment measures in the first year of the projection (instantaneous potential), they are phased in according to adoption schedules that generally align with the diffusion of similar equipment measures. Like the 2019 CPA, we applied the "Retrofit" ramp rates from the 2021 Power Plan directly as diffusion curves. For technical potential, these rates summed up to 100% by the 20th year for all measures.

- **Adoption rates.** Customer adoption rates or take rates are applied to technical potential to estimate Achievable Technical Potential. For equipment measures, the Council's "Lost Opportunity" ramp rates were applied to technical potential with a maximum achievability of 85%-100%, depending on the measure. For non-equipment measures, the Council's "Retrofit" ramp rates have already been applied to calculate technical diffusion. In this case, we multiply each of these by 85% (for most measures) to calculate Achievable Technical Potential. Adoption rates are presented in Appendix B.

3 | ENERGY EFFICIENCY MARKET CHARACTERIZATION

This chapter presents how Avista's customers in Washington and Idaho use electricity in 2021, the base year of the study. We begin with a high-level summary of energy use by state and then delve into each sector.

Energy Use Summary

Total electricity use for Avista in 2021 was 7,996 GWh, 5,277 GWh in Washington, and 2,719 GWh in Idaho. The residential sector accounts for around 50% of annual energy use in both states, followed by commercial at around 40% of annual energy use. For winter peak demand, the total system peak in 2021 was 1,559 MW: 1,089 MW in Washington and 494 MW in Idaho. In both states, the residential sector represents the largest share of the winter peak.

Figure 3-1 Sector-Level Electricity Use in Base Year 2021, Washington

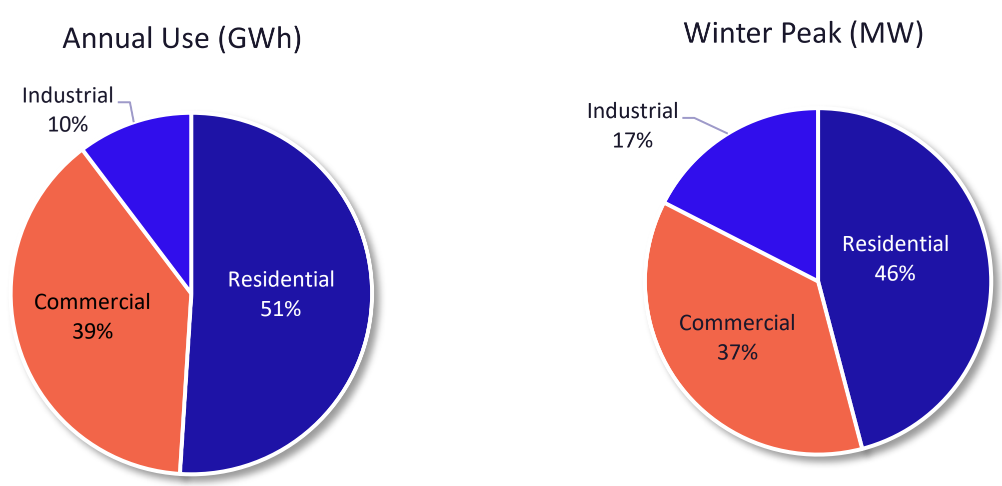


Table 3-1 Avista Sector Control Totals (2021), Washington

Sector	Annual Electricity Use (GWh)	% of Annual Use	Winter Peak Demand (MW)	% of Winter Peak
Residential	2,692	51%	500	46%
Commercial	2,041	39%	399	37%
Industrial	544	10%	190	17%
Total	5,277	100%	1,089	100%

Figure 3-2 Sector-Level Electricity Use in Base Year 2021, Idaho

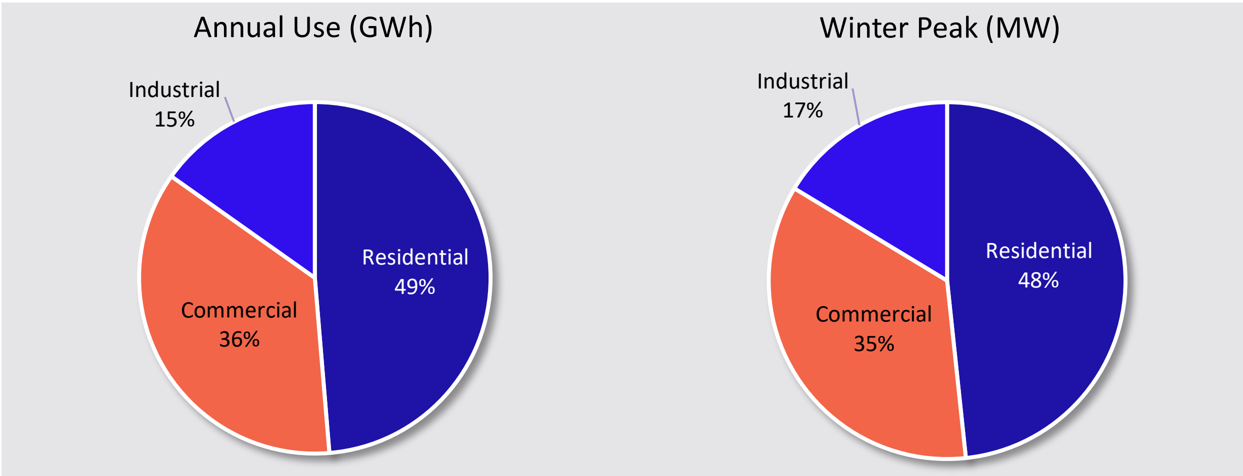


Table 3-2 Avista Sector Control Totals (2021), Idaho

Sector	Annual Electricity Use (GWh)	% of Annual Use	Winter Peak Demand (MW)	% of Winter Peak
Residential	1,324	49%	239	48%
Commercial	982	36%	175	35%
Industrial	413	15%	81	16%
Total	**2,719**	**100%**	**494**	**100%**

Residential Sector

The total number of households and electricity sales were obtained from Avista's customer database. In 2021, Avista provided electric service to 234,506 households in Washington; those households used a total of 2,692 GWh with a winter peak demand of 500 MW. The average use per household at 11,479 kWh is about average compared to other regions of the country. In 2021, Avista provided electric service to 120,131 households in Idaho; those households used a total of 1,324 GWh with winter peak demand of 239 MW. The average use per household was 11,017 kWh. Table 3-3 and Table 3-4 show the total number of households and electricity sales in the six residential segments for each state.

Table 3-3 Residential Sector Control Totals (2021), Washington

Segment	Number of Customers	Electricity Use (GWh)	% of Annual	Annual Use/Customer (kWh/Household)	Winter Peak
Single Family	97,304	1,310	49%	13,466	233
Multi-Family	12,712	96	4%	7,516	20
Mobile Home	8,704	156	6%	17,891	40
Low Income Single Family	62,690	796	30%	12,702	149
Low Income Multi-Family	45,261	221	8%	4,894	32
Low Income Mobile Home	7,836	113	4%	14,358	26
Total	**234,506**	**2,692**	**100%**	**11,479**	**500**

Table 3-4 Residential Sector Control Totals (2021), Idaho

Segment	Number of Customers	Electricity Use (GWh)	% of Annual	Annual Use/Customer (kWh/Household)	Winter Peak
Single Family	79,840	937	35%	11,731	155
Multi-Family	13,065	77	3%	5,876	15
Mobile Home	8,275	115	4%	13,946	27
Low Income Single Family	9,913	119	4%	11,990	24
Low Income Multi-Family	6,890	47	2%	6,868	10
Low Income Mobile Home	2,148	29	1%	13,303	7
Total	**120,131**	**1,324**	**100%**	**11,017**	**239**

Figure 3-3 and Figure 3-4 show the distribution of annual electricity use by end use for all customers in Washington and Idaho, respectively. Two main electricity end uses —space heating and miscellaneous—account for approximately 50% of total usage. Miscellaneous includes furnace fans, pool pumps, electric vehicles, and other "plug" loads (all other usages, such as hair dryers, power tools, coffee makers, etc.). The figures show estimates of winter peak demand by end use. As expected, space heating is the largest contributor to winter peak demand, followed by miscellaneous water heating and lighting.

Figure 3-5 and Figure 3-6 present the electricity intensities by end use and housing type for Washington and Idaho, respectively. Mobile homes have the highest use per customer at 17,891 kWh/year in Washington and 13,946 kWh/year in Idaho.

Figure 3-3 Residential Electricity Use and Winter Peak Demand by End Use (2021), Washington

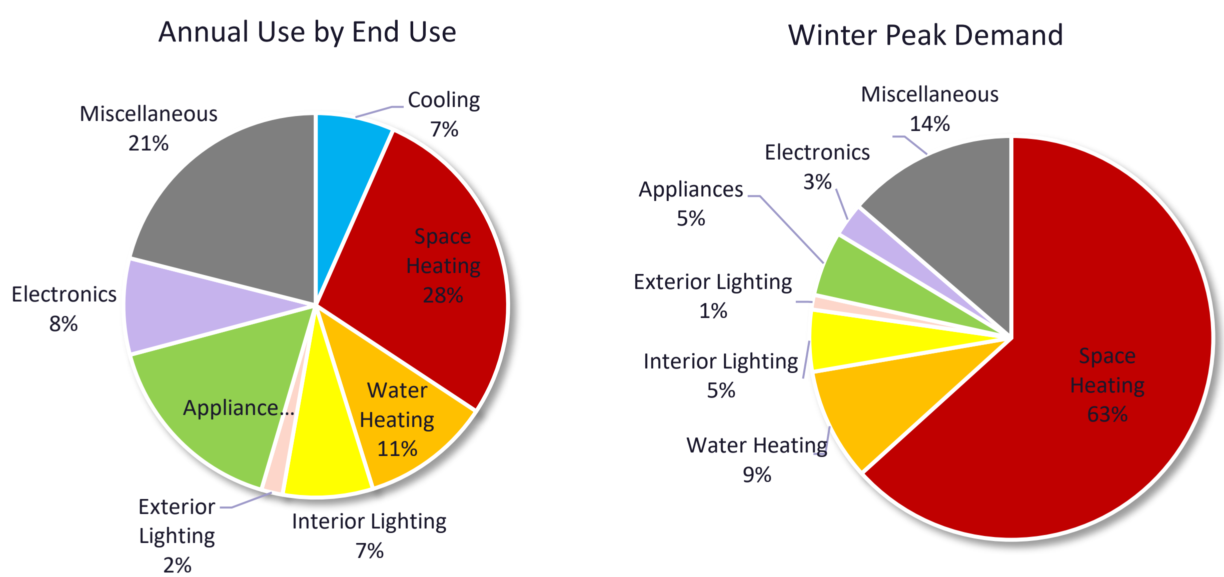


Figure 3-4 Residential Electricity Use and Winter Peak Demand by End Use (2021), Idaho

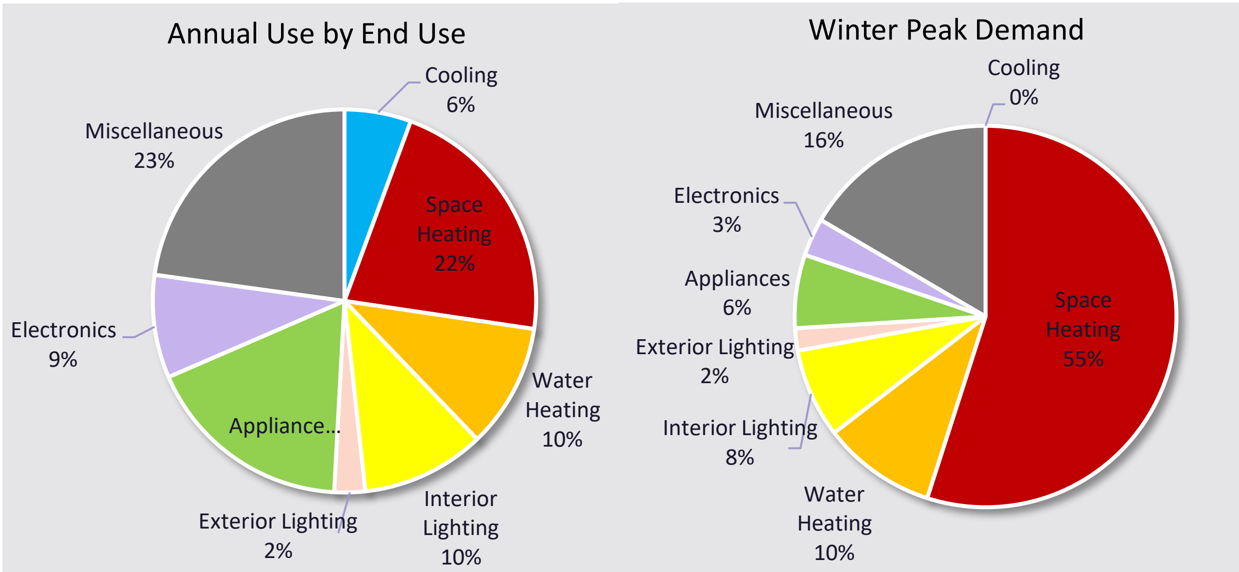


Figure 3-5 Residential Intensity by End Use and Segment (Annual kWh/Household, 2021), Washington

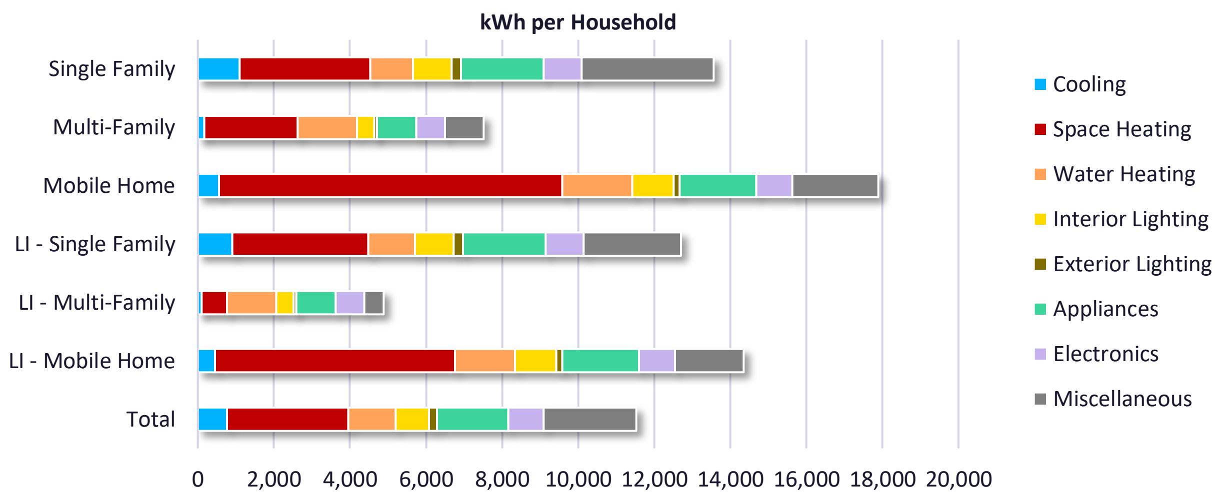
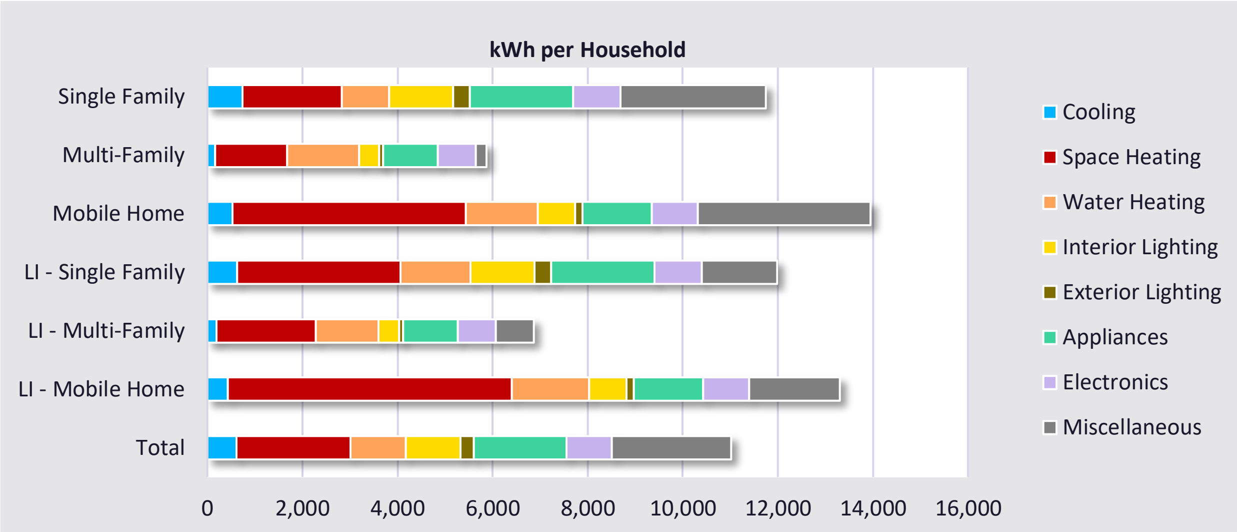


Figure 3-6 Residential Intensity by End Use and Segment (Annual kWh/Household, 2021), Idaho



Commercial Sector

The total electric energy consumed by commercial customers in 2021 was 2,041 GWh in Washington and 982 GWh in Idaho. Avista billing data, CBSA, and secondary data were used to allocate this energy usage to building type segments and to develop estimates of energy intensity (annual kWh/square foot). Using the electricity use and intensity estimates, AEG inferred floor space (the unit of analysis in LoadMAP for the commercial sector). The average building intensities by segment are based on regional information from the CBSA; therefore, the intensity is the same in both states. However, the overall end-use mix is different due to the different mix of building types.

Table 3-5 Commercial Sector Control Totals (2021), Washington

Segment	Electricity Sales (GWh)	% of Total Usage	Intensity (kWh/sq.ft)
Small Office	193	9%	14.3
Large Office	159	8%	25.9
Restaurant	257	13%	46.0
Retail	452	22%	11.9
Grocery	124	6%	28.2
College	114	6%	15.3
School	188	9%	10.0
Health	52	3%	17.7
Lodging	196	10%	18.3
Warehouse	143	7%	6.1
Miscellaneous	163	8%	9.4
Total	**2,041**	**100%**	**13.8**

Table 3-6 Commercial Sector Control Totals (2021), Idaho

Segment	Electricity Sales (GWh)	% of Total Usage	Intensity (kWh/sq.ft)
Small Office	40	2%	14.3
Large Office	124	6%	25.9
Restaurant	151	7%	45.9
Retail	217	11%	11.9
Grocery	142	7%	28.2
College	58	3%	15.3
School	11	1%	10.0
Health	4	0%	17.7
Lodging	85	4%	18.3
Warehouse	35	2%	6.1
Miscellaneous	114	6%	9.4
Total	**982**	**100%**	**15.9**

Figure 3-7 and

Figure 3-8 show the distribution of annual electricity consumption and winter peak demand by end use across all commercial buildings in Washington and Idaho, respectively. Electric usage is dominated by lighting and ventilation, which comprise almost 35% of annual electricity usage. Lighting and ventilation also make up the largest portions of winter peak; however, electric space heating represents a greater part of the peak than it does annual energy.

Figure 3-7 Commercial Electricity Use and Winter Peak Demand by End Use (2021), Washington

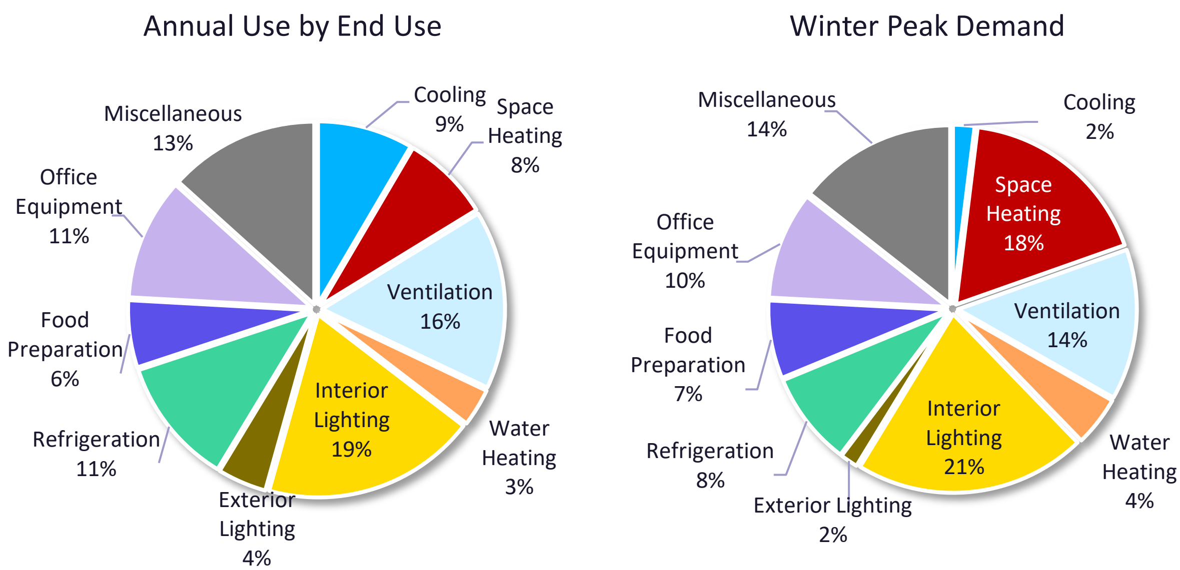


Figure 3-8 Commercial Electricity Use and Winter Peak Demand by End Use (2021), Idaho

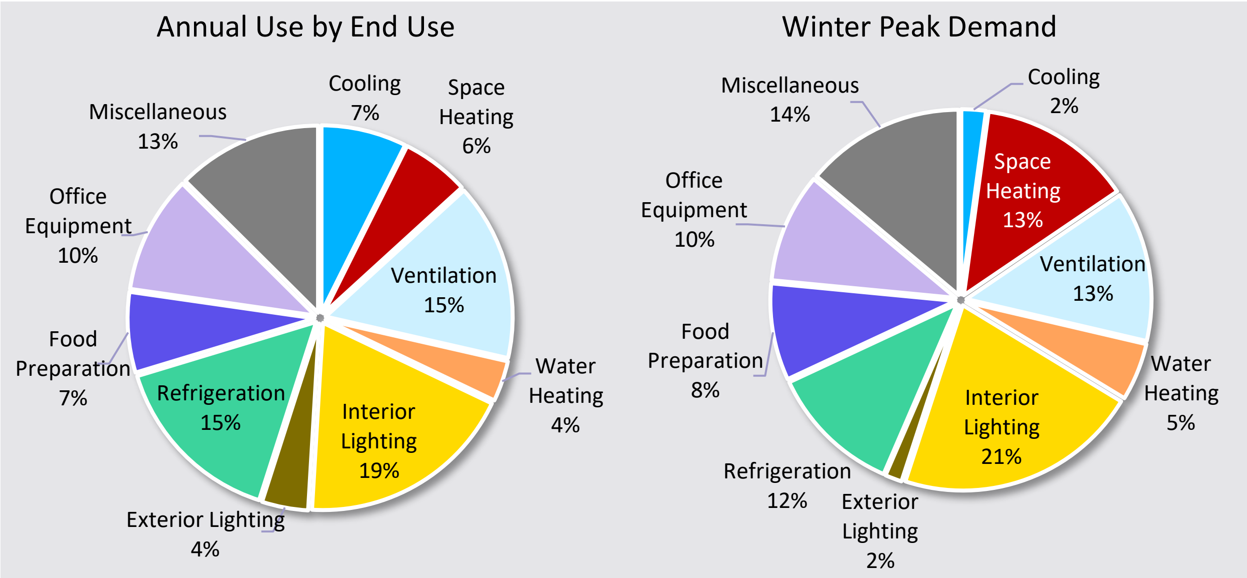


Figure 3-9 and Figure 3-10 present the electricity usage in GWh by end use and segment for Washington and Idaho, respectively. In Washington, large offices, retail, and miscellaneous buildings use the most electricity in the service territory. For Idaho, large and small offices are more balanced in terms of total consumption. HVAC and lighting are the major end uses across most segments, aside from large offices and grocery, where office equipment and refrigeration equipment, respectively, are highly concentrated.

Figure 3-9 Commercial Electricity Usage by End Use Segment (GWh, 2021), Washington

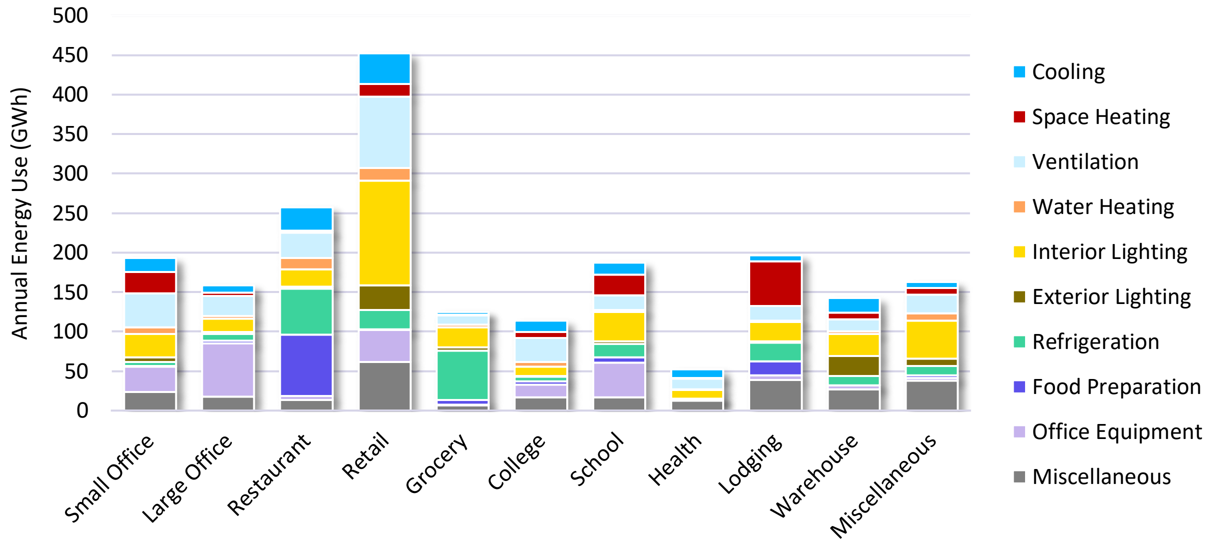
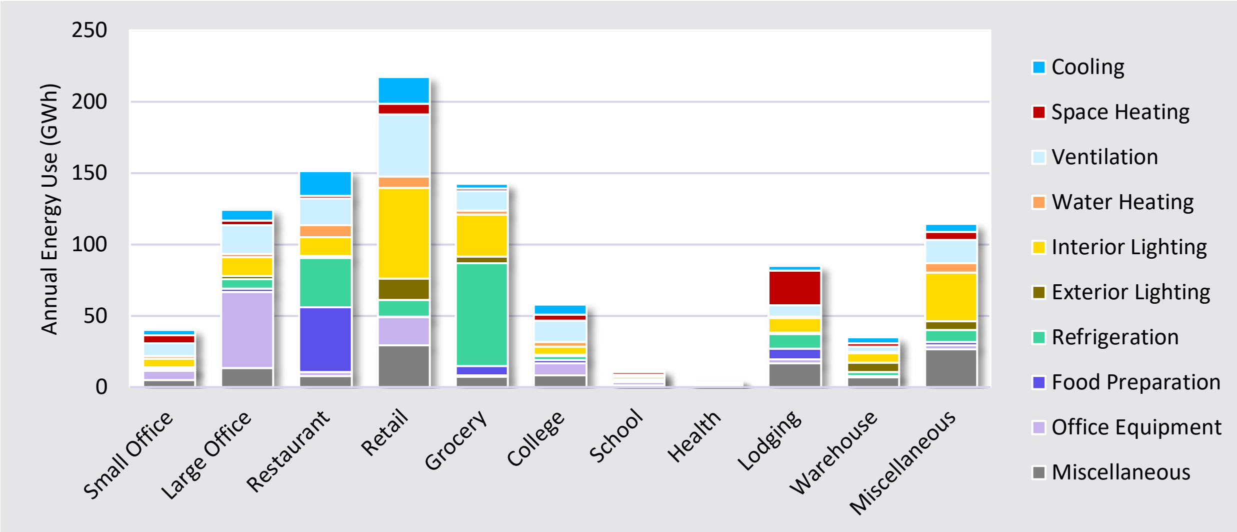


Figure 3-10 Commercial Electricity Usage by End Use Segment (GWh, 2021), Idaho



Industrial Sector

The total electricity used by Avista's industrial customers in 2021 was 958 GWh, 544 GWh in Washington, and 423 GWh in Idaho. Avista billing data and load forecast, NEEA's IFSA, and secondary sources were used to develop estimates of energy intensity (annual kWh/employee). We infer the number of employees (the unit of analysis in LoadMAP for the industrial sector) using the electricity use and intensity estimates.

Table 3-7 Industrial Sector Control Totals (2021)

State	Electricity Sales (GWh)	Intensity (Annual kWh/employee)
Washington	544	99,315
Idaho	413	120,096

Figure 3-11 and Figure 3-12 show the distribution of annual electricity consumption and winter peak demand by end use for all industrial customers in Washington and Idaho, respectively. Motors are the largest overall end use, accounting for over 50% of energy use. Note that motors include a wide range of industrial equipment, such as air compressors and refrigeration compressors, pumps, conveyor motors, and fans. The process end use accounts for over 15% of annual energy use, which includes heating, cooling, refrigeration, and electro-chemical processes.

Figure 3-11 Industrial Electricity Use and Winter Peak Demand by End Use (2021), All Industries, Washington

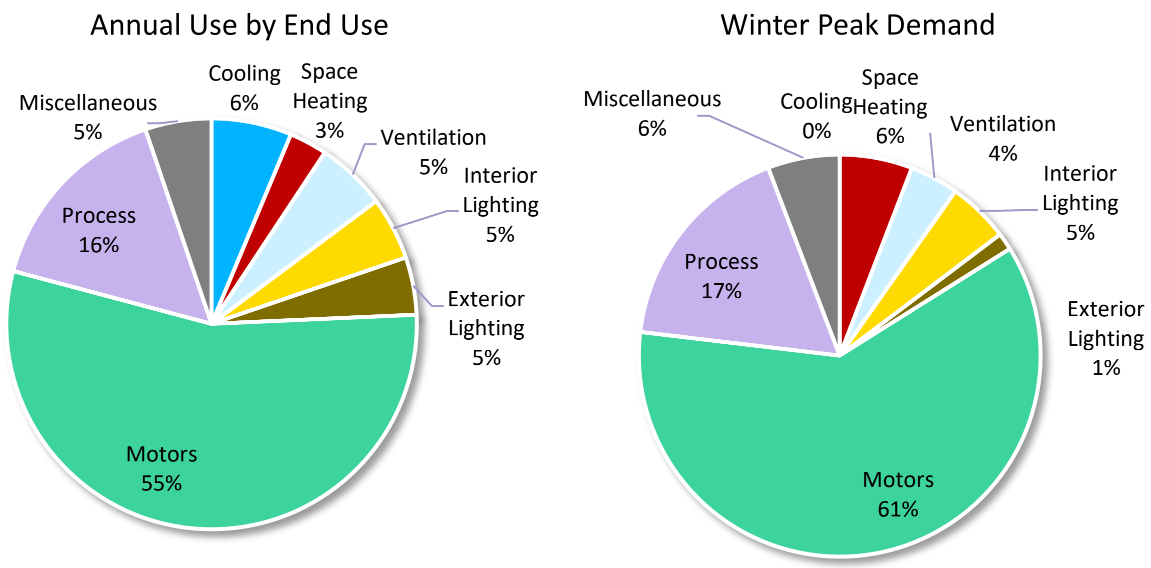
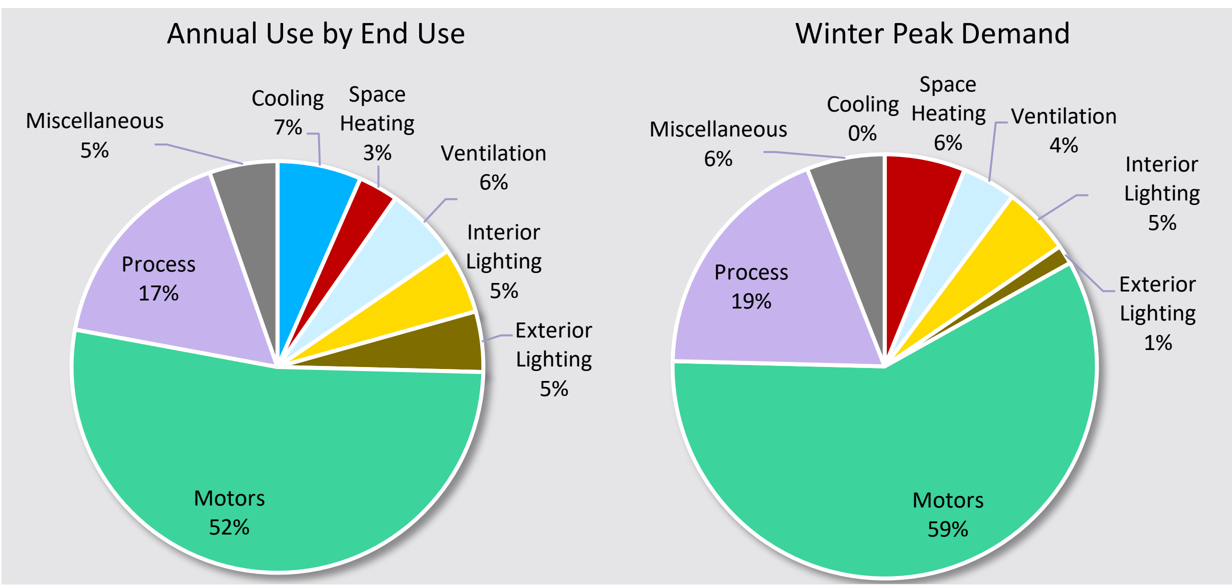


Figure 3-12 Industrial Electricity Use and Winter Peak Demand by End Use (2021), All Industries, Idaho



4 | BASELINE PROJECTION

Prior to developing estimates of energy efficiency potential, AEG developed a baseline end use projection to quantify the likely future consumption in the absence of any future conservation programs. The baseline projection is the foundation for the analysis of savings from future conservation efforts as well as the metric against which potential savings are measured.

This chapter presents the baseline projections developed for each sector and state (as well as a summary), which include projections of annual use in GWh. Annual energy use for 2021 reflects weather-normalized values, while future years of energy use and peak demand reflect normal weather, as defined by Avista.

Residential Sector Baseline Projections

Table 4-1 and Table 4-2 present the baseline projection for electricity by end use for the residential sector in Washington and Idaho, respectively. Overall, in Washington, residential use increases from 2,692 GWh in 2021 to 3,069 GWh in 2045, an increase of 14%. Residential use in Idaho increases from 1,324 GWh in 2021 to 1,721 GWh in 2045, an increase of 30%. This reflects substantial customer growth in both states. Figure 4-1 and Figure 4-3 display the graphical representation of the baseline projection in each state.

Figure 4-2 and Figure 4-4 present the baseline projection of annual electricity use per household in each state. Most noticeable is that lighting use decreases throughout the time period – this is the combined effect of the RTF market baseline assumptions and the EISA lighting backstop coming into effect in 2023.

Table 4-1 Residential Baseline Sales Projection by End Use (GWh), Washington

End Use	2021	2023	2024	2025	2035	2045	% Change ('21-'45)
Cooling	179	148	149	150	168	205	15%
Space Heating	748	796	797	799	820	865	16%
Water Heating	294	297	297	297	300	308	5%
Interior Lighting	205	181	169	156	100	98	-52%
Exterior Lighting	48	42	40	37	21	18	-64%
Appliances	440	450	455	458	505	556	26%
Electronics	219	224	226	228	258	300	37%
Miscellaneous	568	568	566	563	583	830	46%
Generation	-10	-12	-13	-15	-41	-112	1043%
Total	**2,692**	**2,694**	**2,685**	**2,674**	**2,714**	**3,069**	**14%**

Figure 4-1 Residential Baseline Projection by End Use (GWh), Washington

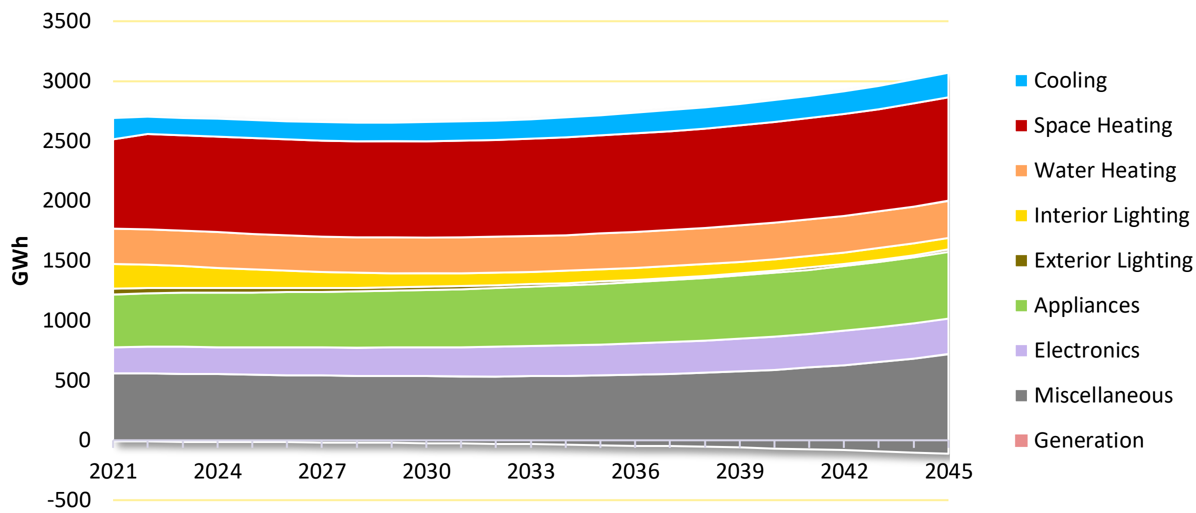


Figure 4-2 Residential Baseline Projection by End Use – Annual Use per Household, Washington

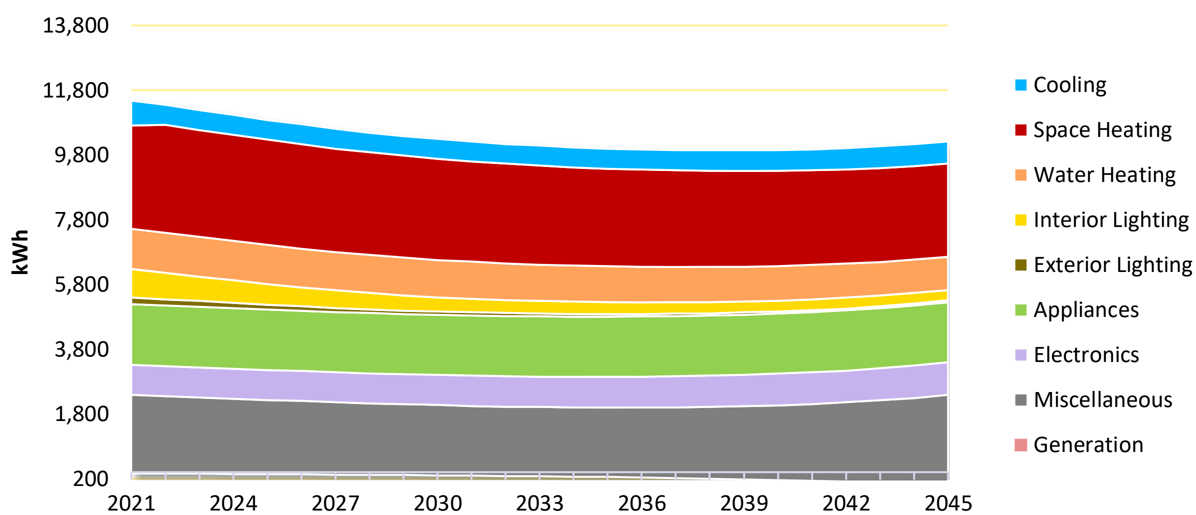


Table 4-2 Residential Baseline Sales Projection by End Use (GWh), Idaho

End Use	2021	2023	2024	2025	2035	2045	% Change ('21-'45)
Cooling	74	63	63	64	75	96	30%
Space Heating	288	309	311	313	334	366	27%
Water Heating	139	143	144	145	159	176	26%
Interior Lighting	138	125	117	109	73	75	-46%
Exterior Lighting	35	30	28	26	16	15	-57%
Appliances	234	242	244	247	281	323	38%
Electronics	115	119	120	121	141	170	47%
Miscellaneous	302	311	315	318	369	512	69%
Generation	-1	-1	-1	-1	-3	-10	1163%
Total	**1,324**	**1,341**	**1,342**	**1,342**	**1,445**	**1,721**	**30%**

Figure 4-3 Residential Baseline Projection by End Use (GWh), Idaho

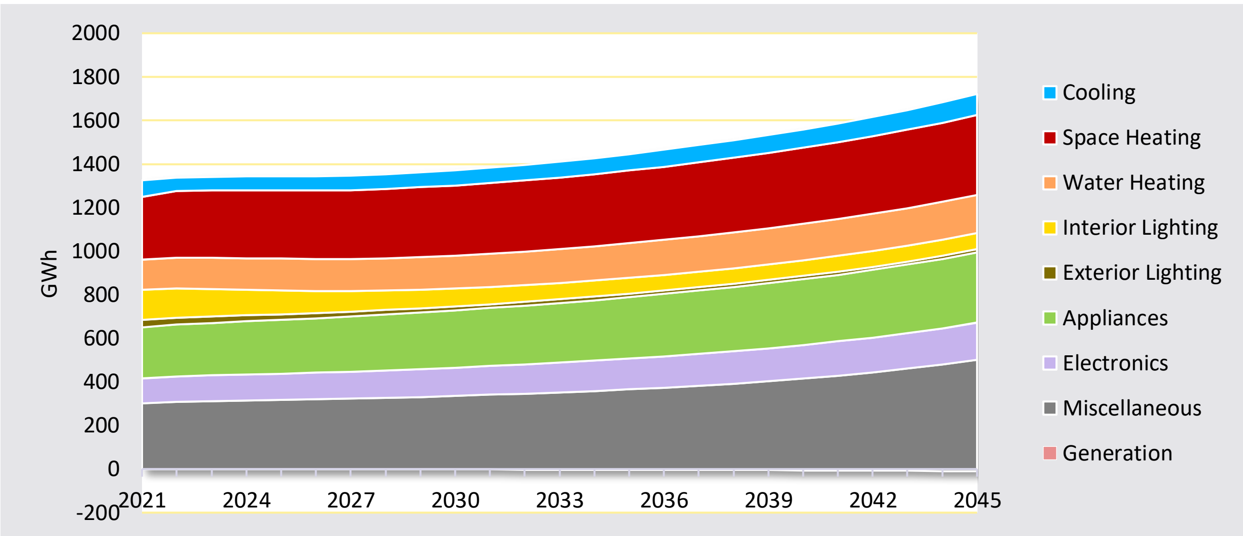
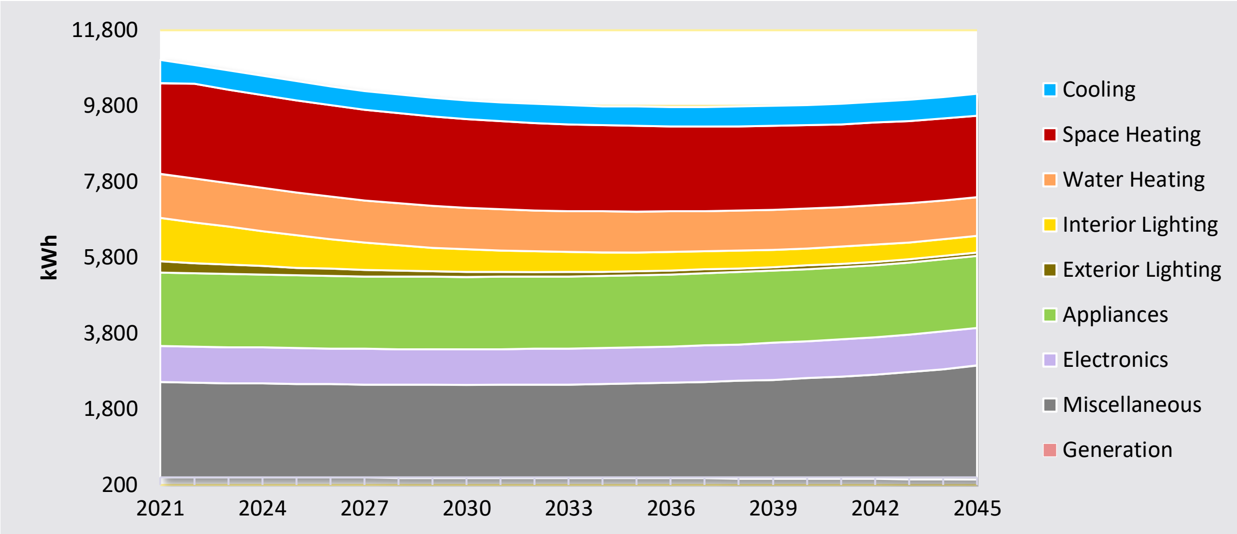


Figure 4-4 Residential Baseline Sales Projection by End Use – Annual Use per Household, Idaho



Commercial Sector Baseline Projections

In Washington, annual electricity use in the commercial sector grows during the overall forecast horizon, starting at 2,041 GWh in 2021, and increasing to 2,197 in 2045, an increase of 8%. In Idaho, annual electricity use will grow from 982 GWh in 2021 to 984 GWh in 2045, an increase of 0.2%.

Table 4-3 Commercial Baseline Sales Projection by End Use (GWh), Washington

End Use	2021	2023	2024	2025	2035	2045	% Change ('21-'45)
Cooling	172	174	174	175	180	189	9%
Space Heating	159	162	163	165	179	195	23%
Ventilation	323	317	314	311	284	283	-12%
Water Heating	68	68	68	67	59	57	-16%
Interior Lighting	386	385	384	379	369	384	-1%
Exterior Lighting	88	87	86	84	76	80	-10%
Appliances	230	232	233	234	248	268	17%
Electronics	121	124	125	126	138	151	25%
Miscellaneous	221	224	225	227	242	259	18%
Generation	272	276	278	280	304	331	22%
Total	**2,041**	**2,049**	**2,051**	**2,048**	**2,079**	**2,197**	**8%**

Table 4-4 Commercial Baseline Sales Projection by End Use (GWh), Idaho

End Use	2021	2023	2024	2025	2035	2045	% Change ('21-'45)
Cooling	72	72	72	72	73	75	4%
Space Heating	58	56	56	57	58	61	5%
Ventilation	150	144	142	140	124	121	-20%
Water Heating	35	35	35	35	38	40	17%
Interior Lighting	185	181	179	177	170	176	-5%
Exterior Lighting	39	38	37	36	31	32	-19%
Appliances	151	147	147	147	151	156	3%
Electronics	68	68	68	69	74	79	16%
Miscellaneous	100	98	98	99	102	105	5%
Generation	123	122	123	123	130	139	13%
Total	**982**	**960**	**958**	**955**	**951**	**984**	**0.2%**

Figure 4-5 Commercial Baseline Projection by End Use, Washington

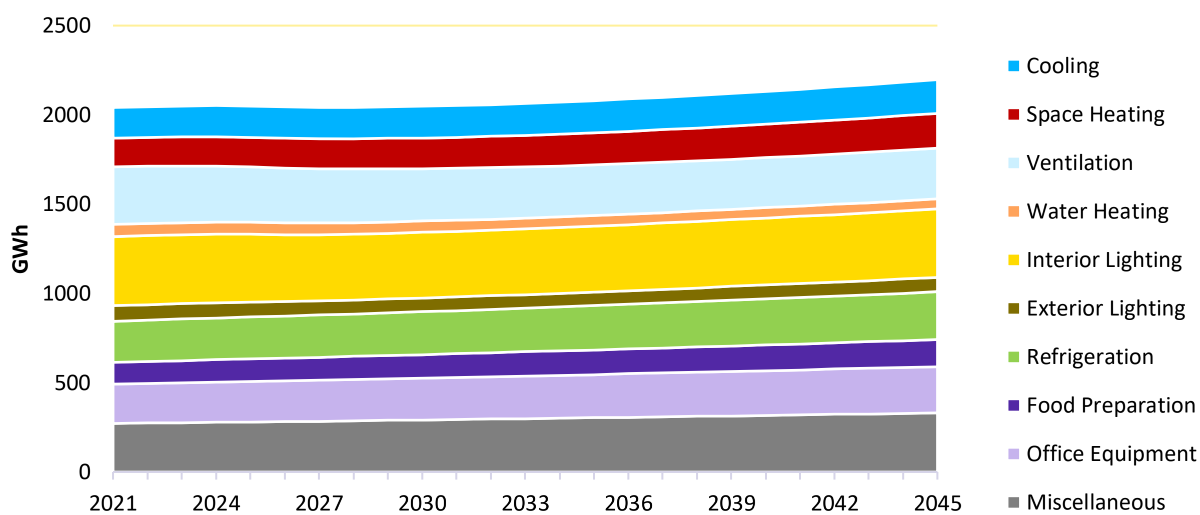


Figure 4-6 Commercial Baseline Sales Projection by End Use – Annual Use per Square Foot, Washington

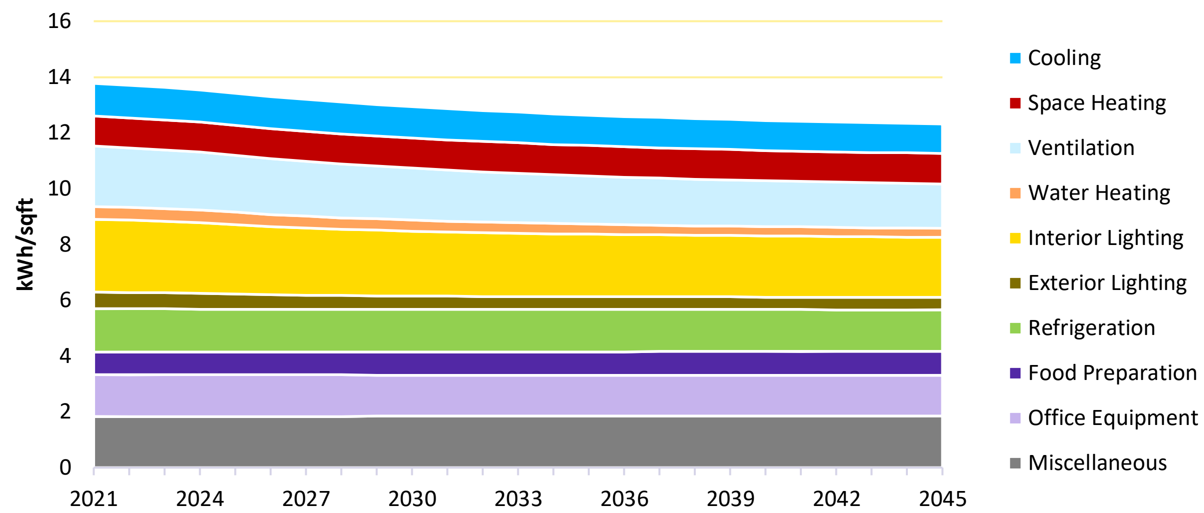


Figure 4-7 Commercial Baseline Projection by End Use, Idaho

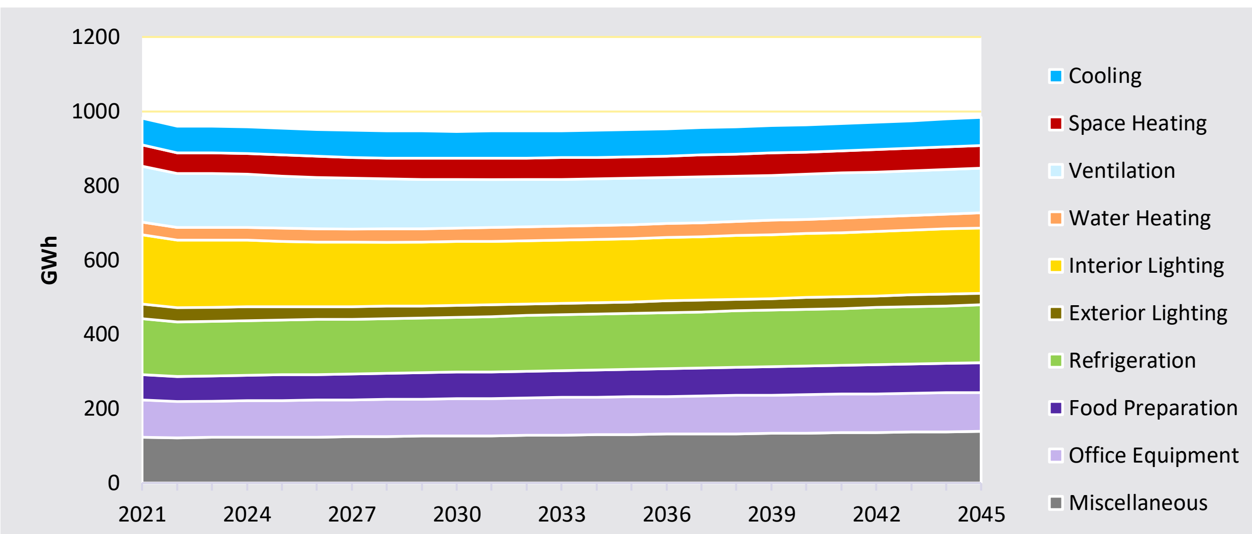
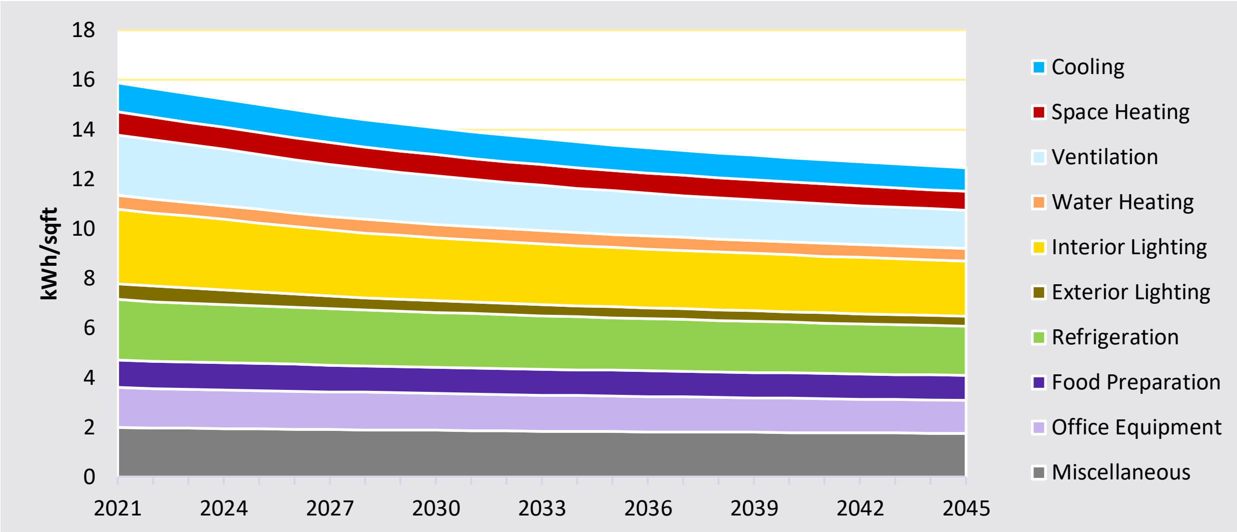


Figure 4-8 Commercial Baseline Sales Projection by End Use – Annual Use per Square Foot, Idaho



Industrial Sector Baseline Projections

Annual industrial use declined by 7% through the forecast horizon, consistent with trends from Avista's industrial load forecast. Overall, in Washington, industrial annual electricity use decreases from 544 GWh in 2021 to 534 GWh in 2045. In Idaho, annual electricity use drops from 413 GWh in 2021 to 316 GWh in 2045.

Table 4-5 Industrial Baseline Projection by End Use (GWh), Washington

End Use	2021	2023	2024	2025	2035	2045	% Change ('21-'45)
Cooling	34	37	37	36	35	34	-2%
Space Heating	16	17	17	17	17	17	1%
Ventilation	30	31	30	30	25	22	-25%
Interior Lighting	27	28	27	27	24	23	-15%
Exterior Lighting	25	24	23	22	19	18	-26%
Process	85	92	92	92	90	87	3%
Motors	299	307	307	307	305	304	2%
Miscellaneous	28	30	30	30	30	29	2%
Total	**544**	**565**	**565**	**561**	**544**	**534**	**-2%**

Table 4-6 Industrial Baseline Projection by End Use (GWh), Idaho

End Use	2021	2023	2024	2025	2035	2045	% Change ('21-'45)
Cooling	27	27	26	26	23	20	-25%
Space Heating	13	13	12	12	11	10	-22%
Ventilation	24	22	22	21	16	14	-43%
Interior Lighting	21	20	20	19	16	14	-35%
Exterior Lighting	20	17	17	16	13	11	-43%
Process	69	68	67	67	60	54	-22%
Motors	217	209	208	207	191	176	-19%
Miscellaneous	22	21	21	21	19	17	-21%
Total	**413**	**398**	**394**	**391**	**350**	**316**	**-24%**

Figure 4-9 Industrial Baseline Projection by End Use (GWh), Washington

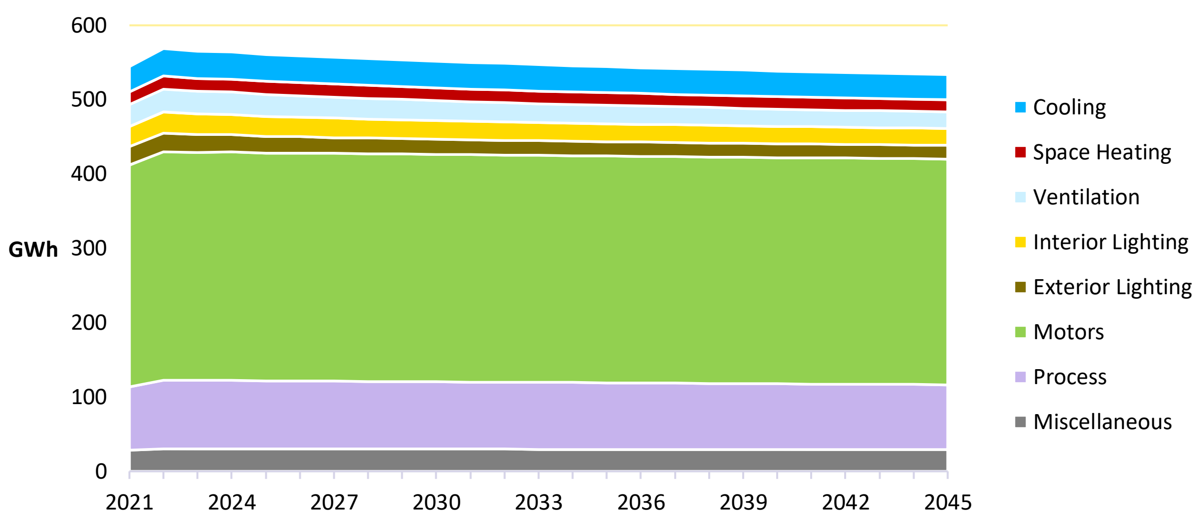


Figure 4-10 Industrial Baseline Sales Projection by End Use – Annual Use per Employee, Washington

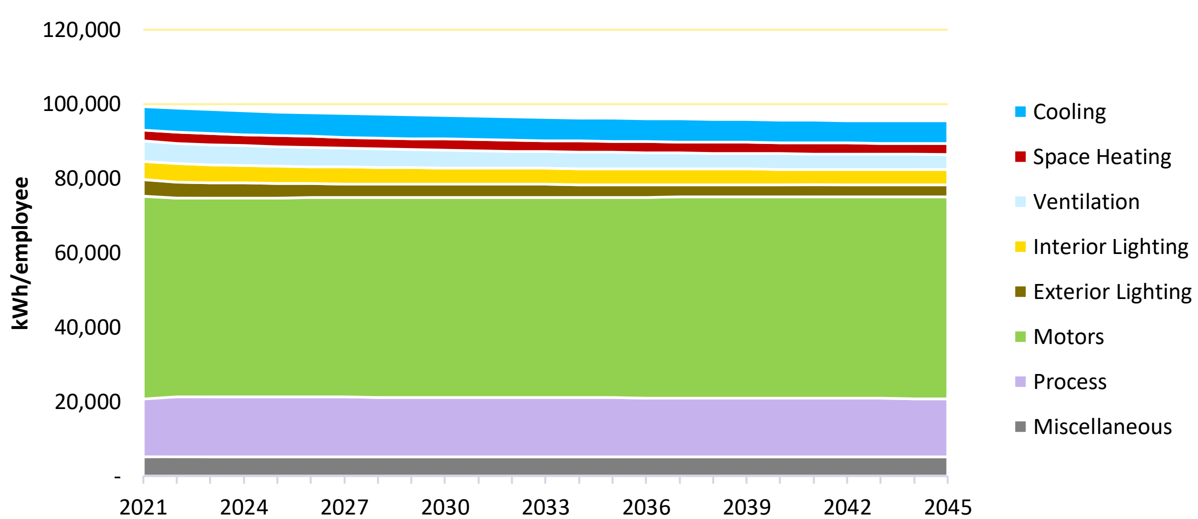


Figure 4-11 Industrial Baseline Projection by End Use (GWh), Idaho

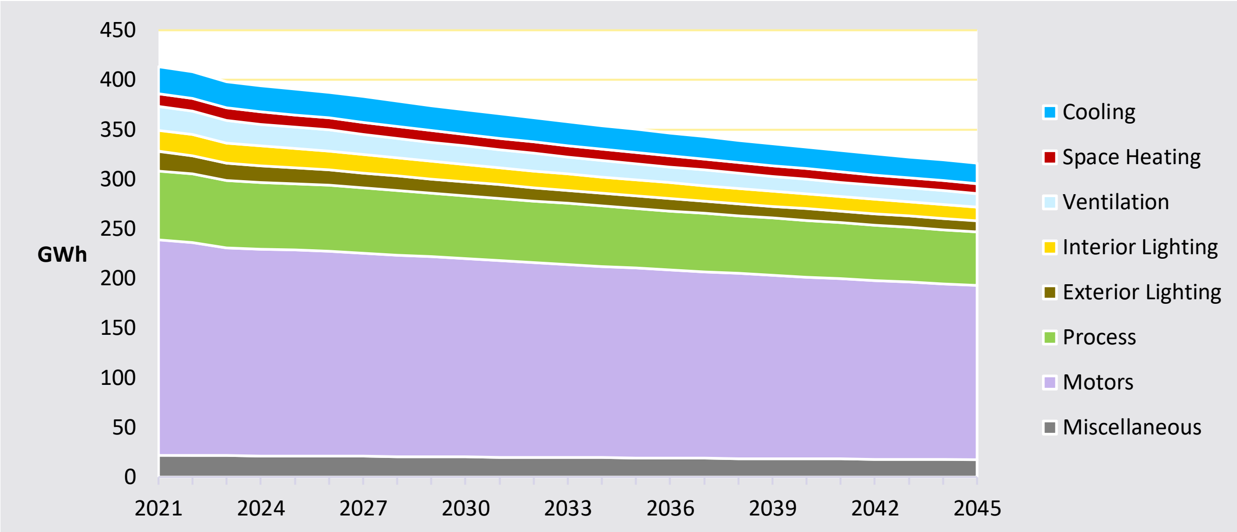
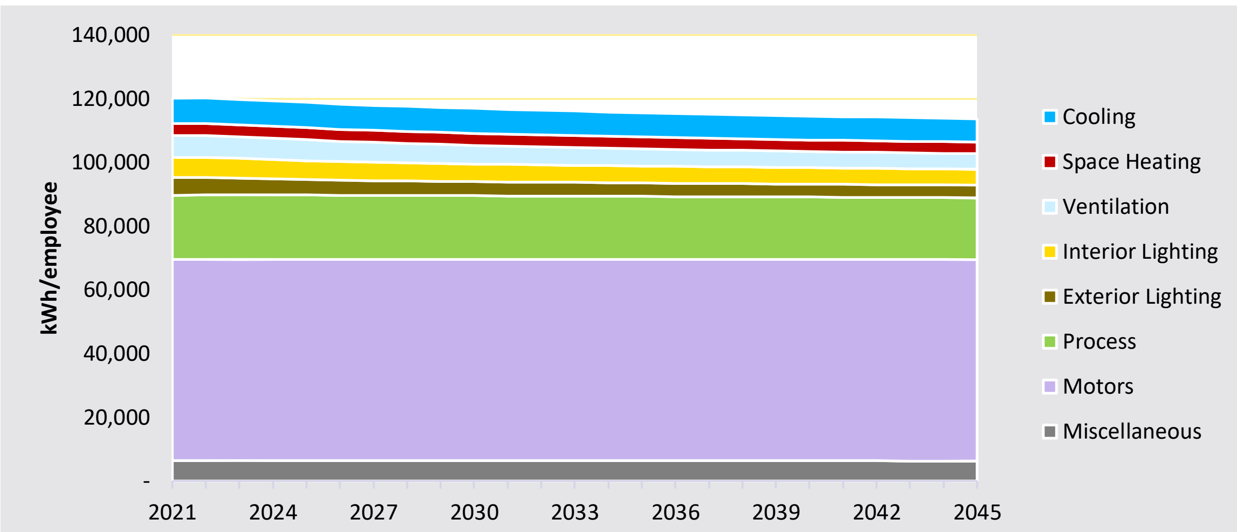


Figure 4-12 Industrial Baseline Sales Projection by End Use – Annual Use per Employee, Idaho



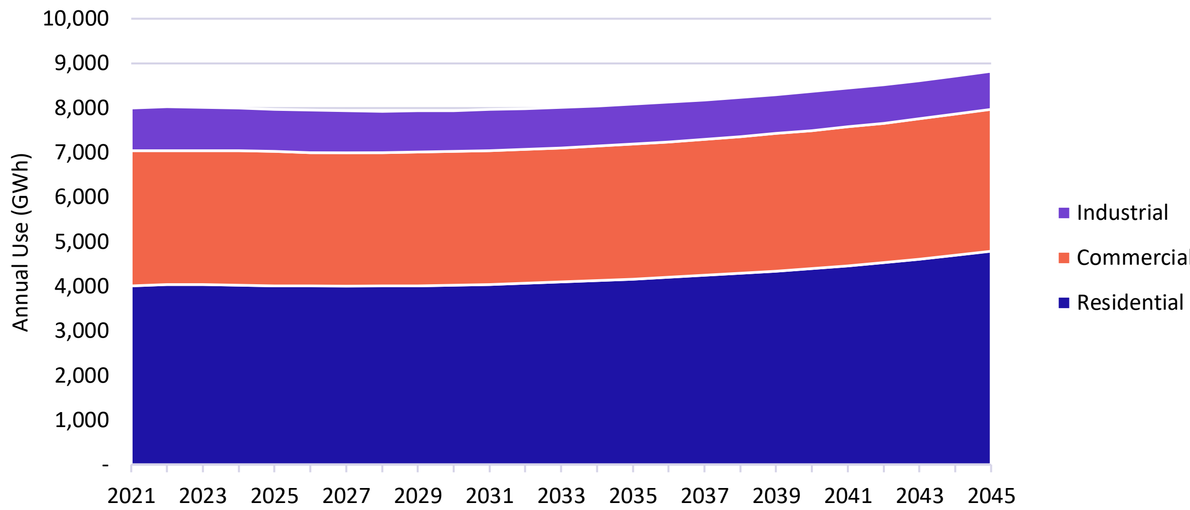
Summary of Baseline Projections Across Sectors and States

Table 4-7 and Figure 4-13 provide a summary of the baseline projection for annual use by sector for the entire Avista electric service territory. Overall, the projection shows steady growth in electricity use, driven primarily by customer growth forecasts.

Table 4-7 Baseline Projection Summary (GWh), Washington and Idaho Combined

End Use	2021	2023	2024	2025	2035	2045	% Change ('21-'45)
Residential	4,015	4,035	4,027	4,016	4,159	4,791	19%
Commercial	3,023	3,010	3,010	3,003	3,031	3,181	5%
Industrial	958	964	959	952	894	850	-11%
Total	**7,996**	**8,009**	**7,996**	**7,971**	**8,084**	**8,821**	**10%**

Figure 4-13 Baseline Projection Summary (GWh), Washington and Idaho Combined



5 | CONSERVATION POTENTIAL

This chapter presents conservation potential results, beginning with a summary of annual energy savings across all three sectors, followed by detailed savings for each sector. Potential is presented for annual energy savings (GWh and aMW) as well as the winter peak demand savings (MW) for selected years. Note that all savings are presented at the customer meter (i.e., excluding line losses).

Overall Summary of Energy Efficiency Potential

Summary of Annual Energy Savings

Table 5-1 and Table 5-2 summarize the energy efficiency potential for each state relative to the baseline projection. Potential as a percent of the baseline projection in each state is shown graphically in Figure 5-1 and Figure 5-2.

- **Technical Potential** reflects the adoption of all conservation measures regardless of cost-effectiveness. For Washington, first-year savings are 100 GWh or 1.9% of the baseline projection. Cumulative savings in 2045 are 1,749 GWh or 30.2% of the baseline. For Idaho, first-year savings are 46 GWh or 1.7% of the baseline projection. Cumulative savings in 2045 are 887 GWh or 29.3% of the baseline.
- **Achievable Technical Potential** modifies Technical Potential by accounting for assumed customer adoption. In Washington, first-year savings potential is 59 GWh or 1.1% of the baseline. In 2045, cumulative achievable technical savings reach 1,346 GWh or 23.2% of the baseline projection. Achievable Technical Potential is approximately 77% of Technical Potential in Washington throughout the forecast horizon. For Idaho, first-year savings are 26 GWh or 1.0% of the baseline, and by 2045, cumulative achievable technical savings will reach 678 GWh, or 22.4% of the baseline. In Idaho, Achievable Technical Potential reflects 76% of Technical Potential throughout the forecast horizon.

Table 5-1 Summary of Energy Efficiency Potential, Washington

	2023	2024	2025	2035	2045
Baseline Projection (GWh)	5,309	5,301	5,283	5,338	5,800
Cumulative Savings (GWh)					
Achievable Technical Potential	59	127	202	1,020	1,346
Technical Potential	100	212	331	1,399	1,749
Cumulative Savings (aMW)					
Achievable Technical Potential	7	14	23	116	154
Technical Potential	11	24	38	160	200
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.1%	2.4%	3.8%	19.1%	23.2%
Technical Potential	1.9%	4.0%	6.3%	26.2%	30.2%

Table 5-2 Summary of Energy Efficiency Potential, Idaho

	2023	2024	2025	2035	2045
Baseline Projection (GWh)	2,700	2,695	2,688	2,747	3,021
Cumulative Savings (GWh)					
Achievable Technical Potential	26	57	91	490	678
Technical Potential	46	98	154	681	887
Cumulative Savings (aMW)					
Achievable Technical Potential	3	6	10	56	77
Technical Potential	5	11	18	78	101
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.0%	2.1%	3.4%	17.8%	22.4%
Technical Potential	1.7%	3.6%	5.7%	24.8%	29.3%

Figure 5-1 Cumulative Energy Efficiency Potential as % of Baseline Projection, Washington

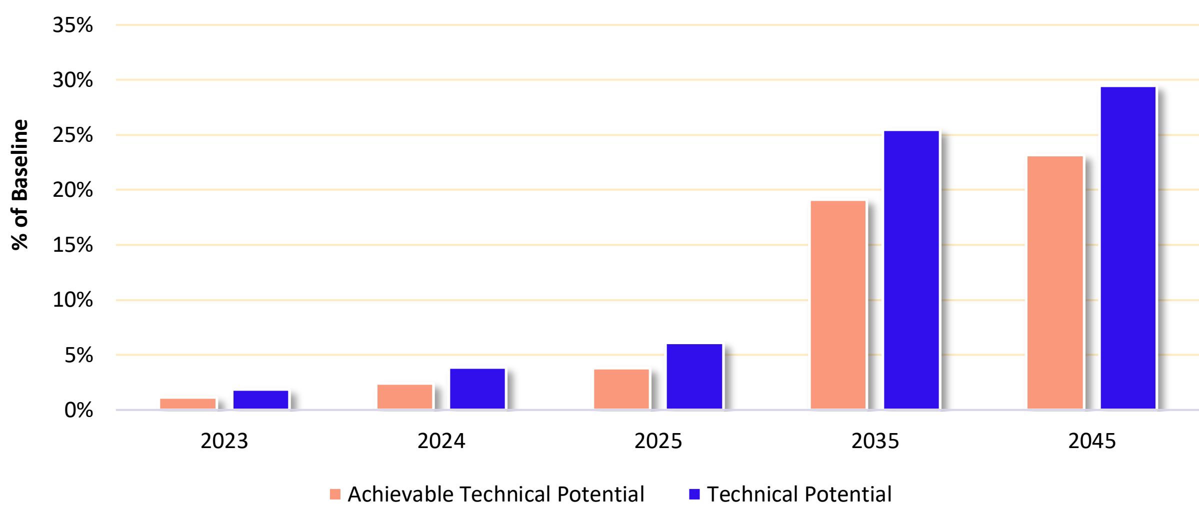
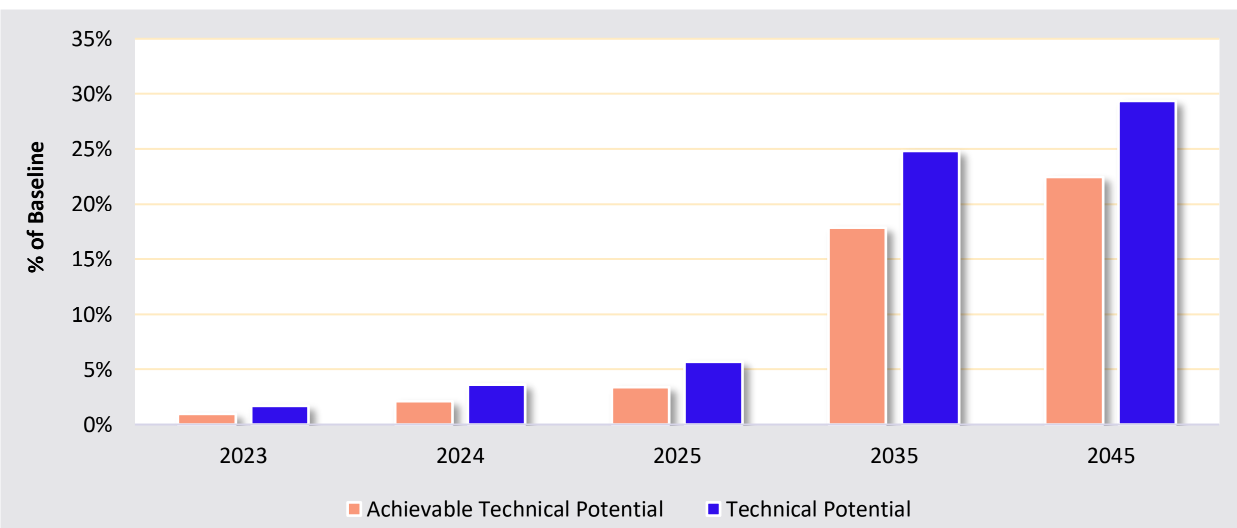


Figure 5-2 Cumulative Energy Efficiency Potential as % of Baseline Projection, Idaho



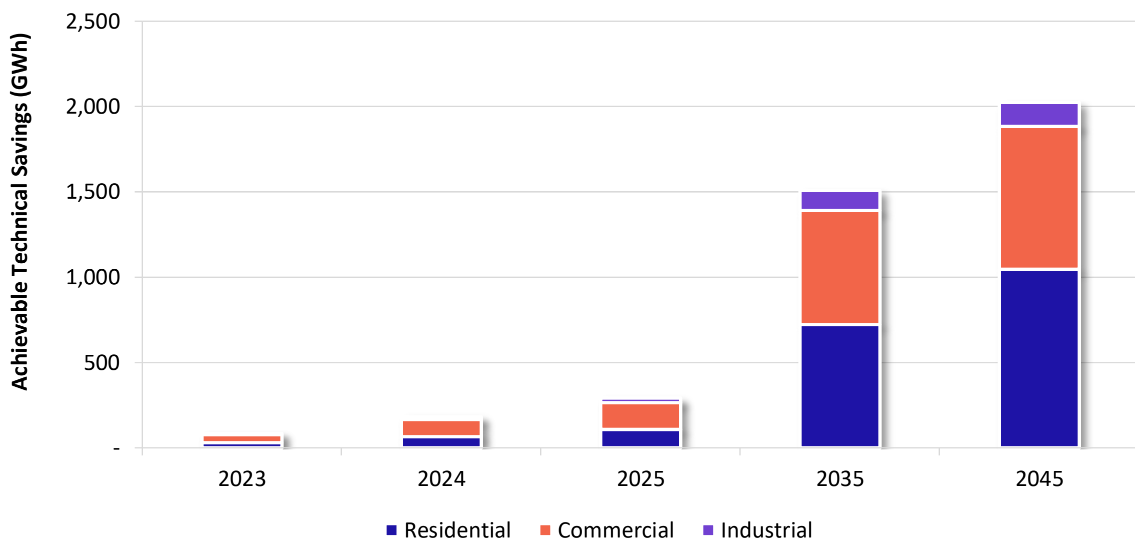
Summary of Conservation Potential by Sector

Table 5-3 and Figure 5-3 summarize the Achievable Technical Potential by sector for both states combined. As shown, the commercial sector represents the largest share of Achievable Technical Potential in the early years, with the residential sector representing larger potential over the longer term.

Table 5-3 Achievable Technical Conservation Potential by Sector, Washington and Idaho Combined

	2023	2024	2025	2035	2045
Cumulative Savings (GWh)					
Residential	31	67	109	722	1,046
Commercial	47	99	156	667	836
Industrial	8	18	28	121	141
Total	**86**	**183**	**293**	**1,510**	**2,023**
Cumulative Savings (aMW)					
Residential	3	8	12	82	119
Commercial	5	11	18	76	95
Industrial	1	2	3	14	16
Total	10	21	33	172	231

Figure 5-3 Achievable Technical Conservation Potential by Sector, Washington and Idaho Combined



Residential Conservation Potential

Table 5-4 and Table 5-5 present state-specific estimates of conservation potential for the residential sector in terms of annual energy savings. In Washington, residential Achievable Technical Potential in 2023 is 23 GWh or 0.9% of the baseline projection. By 2045, cumulative Achievable Technical Potential reaches 700 GWh or 22.8% of the baseline projection. In Idaho, 2023 Achievable Technical Potential is 7 GWh or 0.6% of the baseline, and by 2045 cumulative Achievable Technical potential reaches 40 GWh or 20.1% of the baseline.

Figure 5-4 and Figure 5-5 show potential as a percent of the baseline projection in each state.

Table 5-4 Residential Conservation Potential, Washington

	2023	2024	2025	2035	2045
Baseline Projection (GWh)	2,694	2,685	2,674	2,714	3,069
Cumulative Savings (GWh)					
Achievable Technical Potential	23	50	82	505	700
Technical Potential	45	97	155	764	979
Cumulative Savings (aMW)					
Achievable Technical Potential	3	6	9	58	80
Technical Potential	5	11	18	87	112
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	0.9%	1.9%	3.1%	18.6%	22.8%
Technical Potential	1.7%	3.6%	5.8%	28.2%	31.9%

Table 5-5 Residential Conservation Potential, Idaho

	2023	2024	2025	2035	2045
Baseline Projection (GWh)	1,341	1,342	1,342	1,445	1,721
Cumulative Savings (GWh)					
Achievable Technical Potential	7	16	27	218	346
Technical Potential	18	38	61	344	486
Cumulative Savings (aMW)					
Achievable Technical Potential	1	2	3	25	40
Technical Potential	2	4	7	39	55
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	0.6%	1.2%	2.0%	15.1%	20.1%
Technical Potential	1.3%	2.8%	4.5%	23.8%	28.2%

Figure 5-4 Residential Cumulative Conservation Potential as a % of the Baseline Projection, Washington

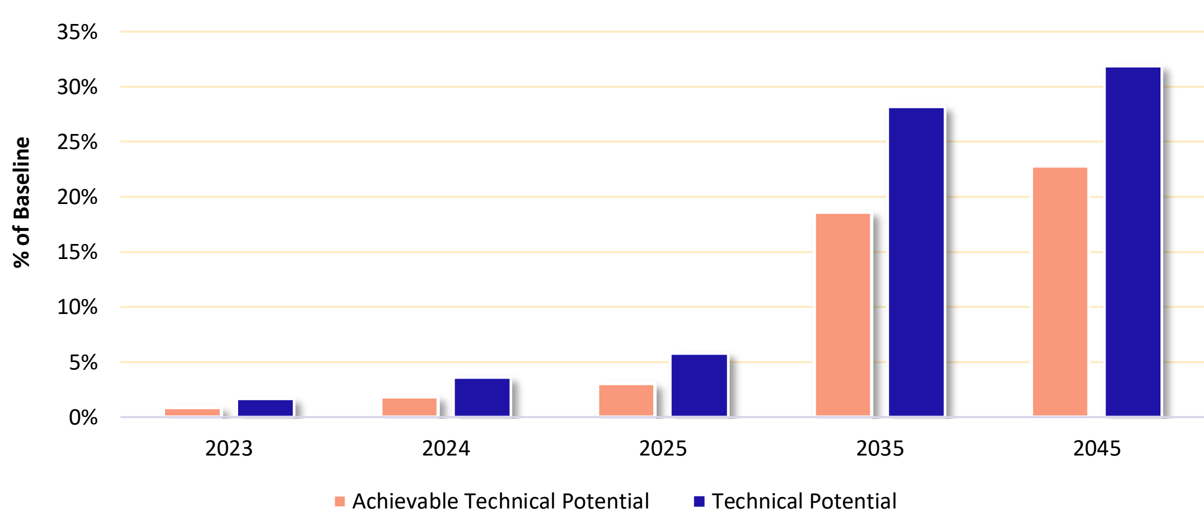


Figure 5-5 Residential Cumulative Conservation Potential as a % of the Baseline Projection, Idaho

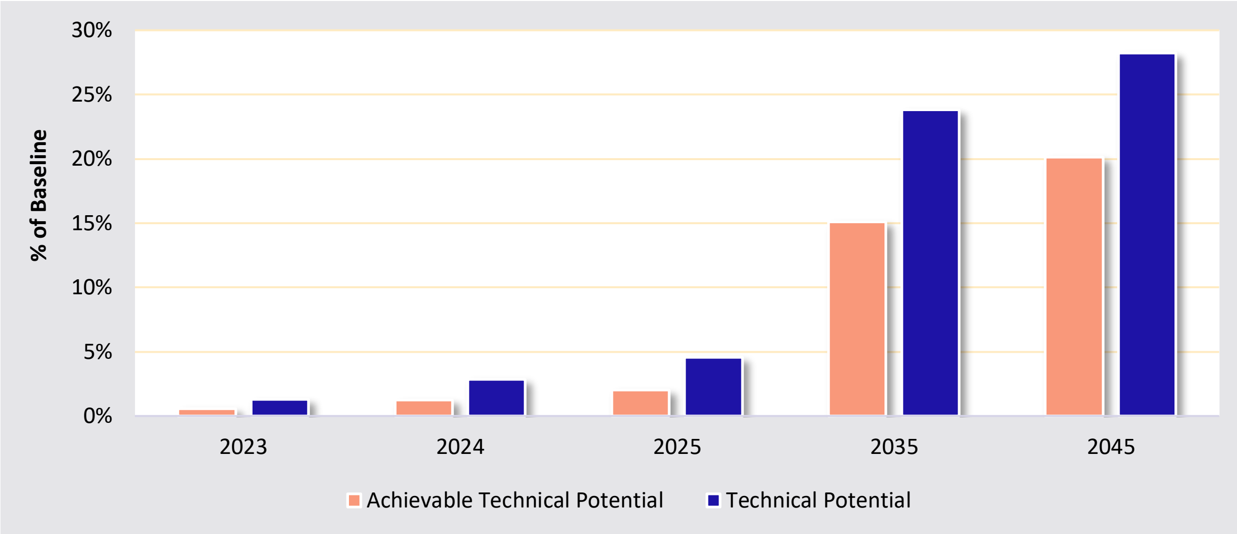


Figure 5-6**Error! Reference source not found.** presents the cumulative residential Achievable Technical Potential by end use in Washington. Space heating and water heating account for a substantial portion of the savings throughout the forecast horizon. Weatherization, ductless heat pumps, and heat pump water heaters account for a large portion of potential over the 20-year study period. LED lighting, while still present, is reduced in comparison to prior studies, as RTF market baseline assumptions and the Washington state lighting standard have moved a substantial amount of potential from those technologies into the baseline projection.

Figure 5-6 Residential Cumulative Achievable Technical Potential by End Use, Washington

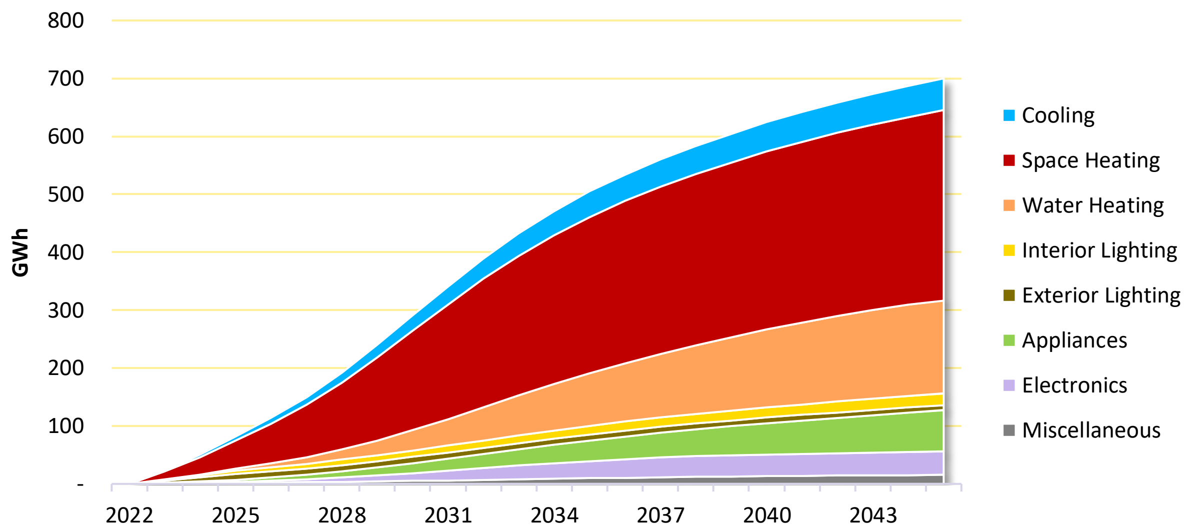


Table 5-6 identifies the top 20 residential measures from the perspective of cumulative Achievable Technical Potential for Washington in 2024, the second year of the planning horizon. The top three measures include ENERGY STAR- Connected Thermostat, Windows – Low-e Storm Addition, and Exterior Lighting – Photovoltaic Installation. Note that achievable technical savings do not screen for cost-effectiveness, and some measures are expected to be screened out during the IRP process.

Table 5-6 Residential Top Measures in 2024, Washington

Rank	Residential Measure	2024 Cumulative Energy Savings (MWh)	% of Total
1	Connected Thermostat - ENERGY STAR (1.0)	8,611	17%
2	Windows - Low-e Storm Addition	5,390	11%
3	Exterior Lighting - Photovoltaic Installation	5,250	10%
4	HVAC - Maintenance and Tune-Up	4,798	10%
5	Home Energy Management System (HEMS)	4,079	8%
6	General Service Lighting	1,586	3%
7	Windows - High Efficiency (Class 22)	1,422	3%
8	Windows - High Efficiency (Class 30)	1,253	2%
9	Insulation - Floor Installation	1,177	2%
10	Water Heater (<= 55 Gal)	1,026	2%
11	Insulation - Ceiling Upgrade	1,006	2%
12	Insulation - Wall Cavity Upgrade	973	2%
13	Insulation - Ceiling Installation	958	2%
14	Building Shell - Air Sealing (Infiltration Control)	955	2%
15	Insulation - Floor Upgrade	913	2%
16	Building Shell - Whole-Home Aerosol Sealing	865	2%
17	Interior Lighting - ENERGY STAR Skylights	847	2%
18	Supplement Central System with Ductless Mini Split Heat Pump	839	2%
19	Exterior Lighting - Timeclock Installation	635	1%
20	Interior Lighting - Occupancy Sensors	574	1%
	Total of Top 20 Measures	**43,157**	**86%**
	Total Cumulative Savings	**50,176**	**100%**

Figure 5-7**Error! Reference source not found.** presents the cumulative residential Achievable Technical Potential by end use in Idaho. Results are similar to Washington, where the majority of the savings come from space heating and water heating measures.

Figure 5-7 Residential Cumulative Achievable Technical Potential by End Use, Idaho

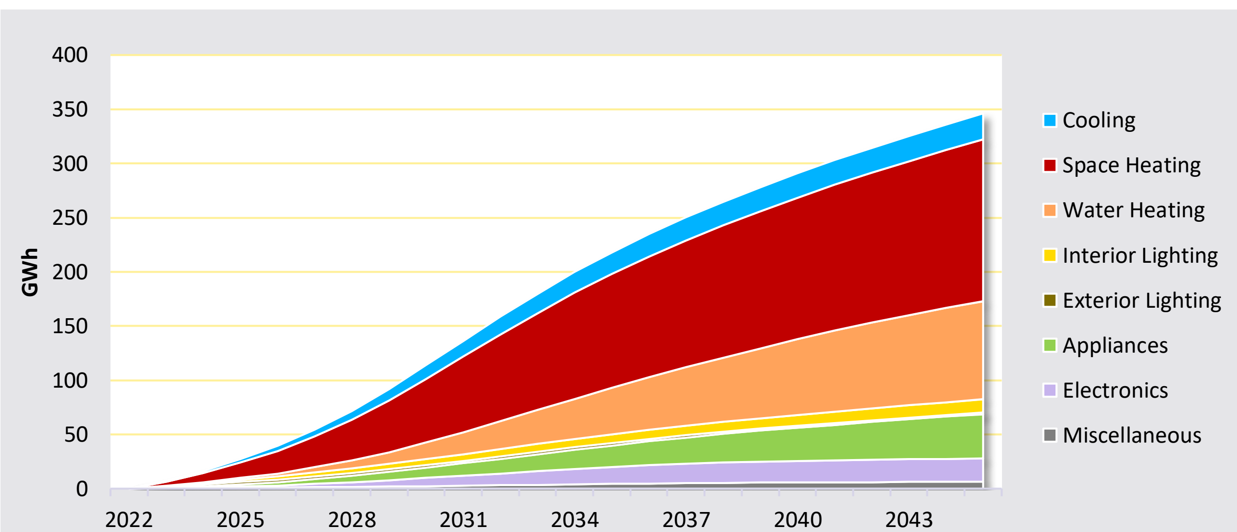


Table 5-7 shows the top residential measures for Idaho in 2024. The top three measures include ENERGY STAR-Connected Thermostat, Windows – Low-e Storm Addition and Home Energy Management Systems. Note that Achievable Technical Potential is not screened for cost-effectiveness, and some measures are expected to be screened out during the IRP process.

Table 5-7 Residential Top Measures in 2024, Idaho

Rank	Residential Measure	2024 Cumulative Energy Savings (MWh)	% of Total
1	Windows - Low-e Storm Addition	1,797	11%
2	Home Energy Management System (HEMS)	1,459	9%
3	Connected Thermostat - ENERGY STAR (1.0)	1,340	8%
4	Exterior Lighting - Photovoltaic Installation	1,253	8%
5	Insulation - Floor Installation	1,079	7%
6	HVAC - Maintenance and Tune-Up	936	6%
7	Insulation - Ceiling Installation	649	4%
8	Insulation - Wall Cavity Upgrade	574	4%
9	Water Heater (<= 55 Gal)	454	3%
10	Interior Lighting - ENERGY STAR Skylights	441	3%
11	Supplement Central System with Ductless Mini Split Heat Pump	428	3%
12	Building Shell - Whole-Home Aerosol Sealing	424	3%
13	Windows - High Efficiency (Class 22)	354	2%
14	Building Shell - Air Sealing (Infiltration Control)	327	2%
15	Windows - High Efficiency (Class 30)	295	2%
16	Insulation - Ceiling Upgrade	290	2%
17	Insulation - Wall Sheathing	288	2%
18	Interior Lighting - Occupancy Sensors	288	2%
19	Refrigerator - Decommissioning and Recycling	284	2%
20	Insulation - Floor Upgrade	248	2%
	Total of Top 20 Measures	**13,210**	**81%**
	Total Cumulative Savings	**16,366**	**100%**

Commercial Conservation Potential

Table 5-8 and Table 5-9 present state-specific estimates of conservation potential for the commercial sector. For Washington, Achievable Technical Potential is 31 GWh in 2023 or 1.5% of the baseline projection. By 2045, achievable technical savings are 560 GWh or 25.5% of the baseline projection. For Idaho, first-year Achievable Technical Potential is 16 GWh or 1.6% of the baseline, and by 2045, cumulative Achievable Technical Potential reaches 276 GWh or 28.0% of the baseline.

Table 5-8 Commercial Conservation Potential, Washington

	2023	2024	2025	2035	2045
Baseline Projection (GWh)	2,049	2,051	2,048	2,079	2,197
Cumulative Savings (GWh)					
Achievable Technical Potential	31	66	104	444	560
Technical Potential	48	100	155	546	666
Cumulative Savings (aMW)					
Achievable Technical Potential	4	8	12	51	64
Technical Potential	6	11	18	62	76
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.5%	3.2%	5.1%	21.3%	25.5%
Technical Potential	2.4%	4.9%	7.6%	26.3%	30.3%

Table 5-9 Commercial Conservation Potential, Idaho

	2023	2024	2025	2035	2045
Baseline Projection (GWh)	960	958	955	951	984
Cumulative Savings (GWh)					
Achievable Technical Potential	16	33	52	223	276
Technical Potential	24	50	77	274	327
Cumulative Savings (aMW)					
Achievable Technical Potential	2	4	6	25	31
Technical Potential	3	6	9	31	37
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.6%	3.4%	5.4%	23.5%	28.0%
Technical Potential	2.5%	5.2%	8.1%	28.8%	33.2%

Figure 5-8 Commercial Cumulative Conservation Potential, Washington

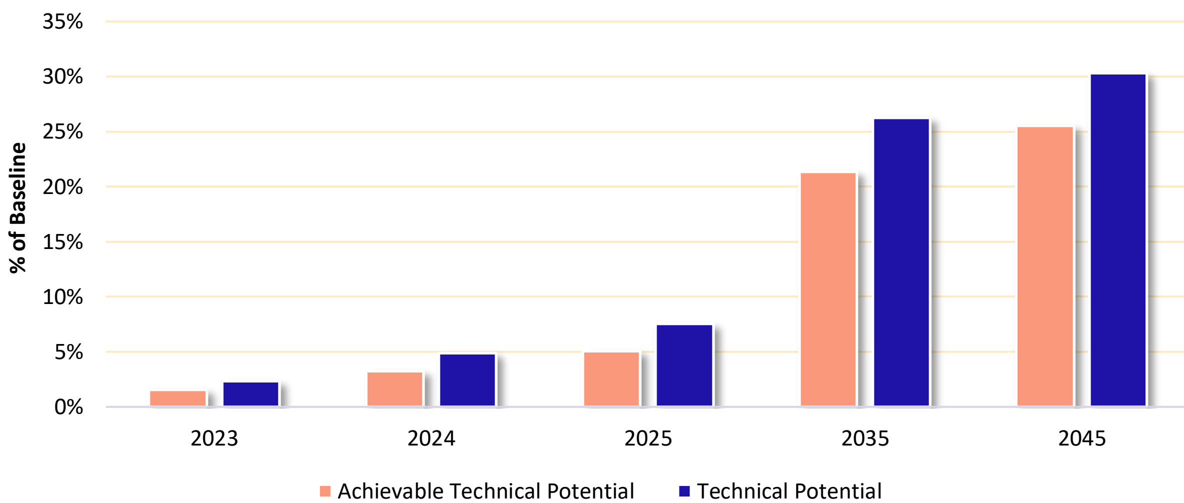


Figure 5-9 Commercial Cumulative Conservation Potential, Idaho

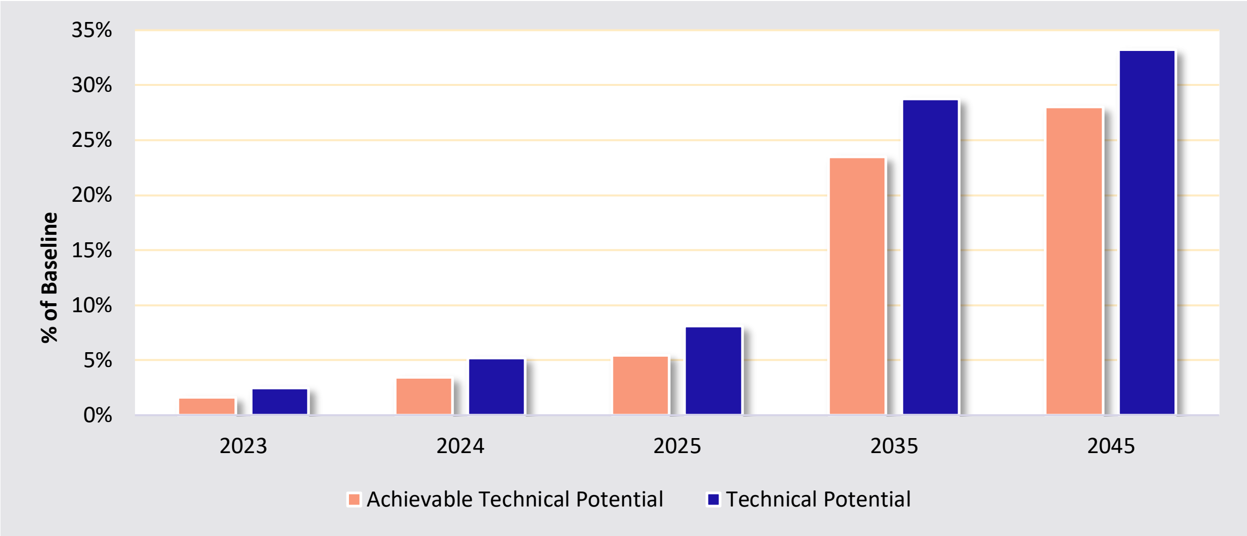


Figure 5-10 presents a forecast of cumulative commercial energy savings by end use in Washington. HVAC end uses (cooling, space heating and ventilation) paired with interior lighting account for a substantial portion of the savings throughout the forecast horizon.

Figure 5-10 Commercial Cumulative Achievable Technical Potential by End Use, Washington

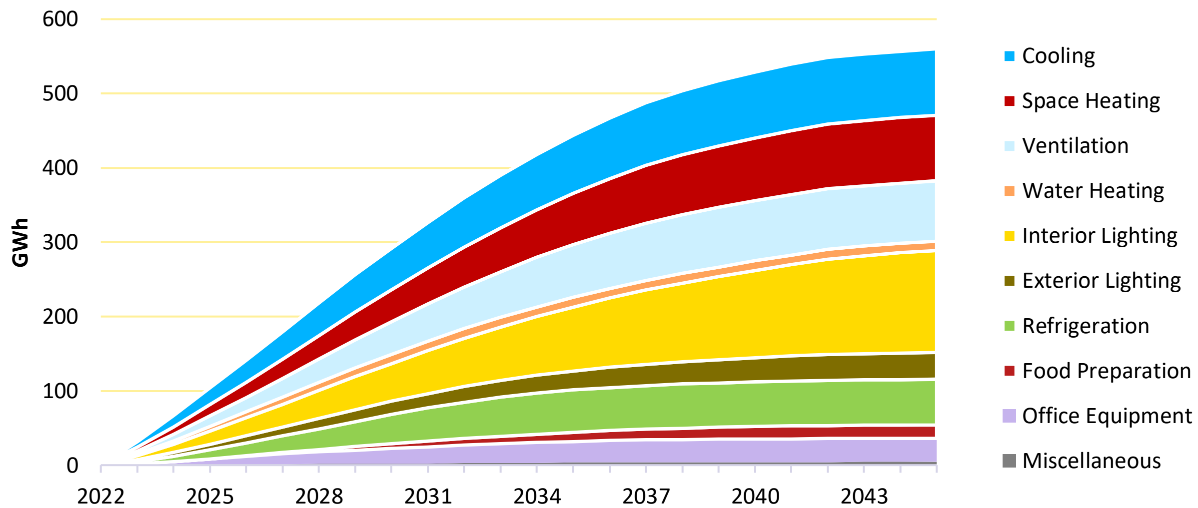


Table 5-10 identifies the top 20 commercial sector measures from the perspective of annual energy savings in 2024 in Washington. Linear lighting is included in the top 3 measures. Although the market has seen significant penetration of LEDs in some applications, newer systems – particularly those with built-in occupancy sensors or other controls – still represent significant savings opportunities. Whole building measures such as Retrocommissioning and Strategic Energy Management contribute a significant portion to the potential.

Table 5-10 Commercial Top Measures in 2024, Washington

Rank	Commercial Measure	2024 Cumulative Energy Savings (MWh)	% of Total
1	Ductless Mini Split Heat Pump	13,661	21%
2	Linear Lighting	8,342	13%
3	Retrocommissioning	5,042	8%
4	Strategic Energy Management	3,951	6%
5	HVAC - Dedicated Outdoor Air System (DOAS)	2,727	4%
6	Ventilation - Demand Controlled	2,572	4%
7	Chiller - Chilled Water Reset	1,857	3%
8	Water Heater - Pipe Insulation	1,589	2%
9	Exterior Lighting - Photovoltaic Installation	1,540	2%
10	Desktop Computer	1,441	2%
11	High-Bay Lighting	1,363	2%
12	Refrigeration - High Efficiency Compressor	1,288	2%
13	Ventilation - Permanent Magnet Synchronous Fan Motor	1,191	2%
14	Chiller - Thermal Energy Storage	1,110	2%
15	Water Heater - Motion Control Faucet	1,044	2%
16	Advanced Kitchen Ventilation Controls	995	2%
17	Water Heater - Solar System	934	1%
18	Ventilation - Fan Drive Improvements	923	1%
19	General Service Lighting	851	1%
20	Chiller - Variable Speed Fans	791	1%
	Total of Top 20 Measures	**53,214**	**80%**
	Total Cumulative Savings	**66,201**	**100%**

Figure 5-11 presents a forecast of cumulative commercial energy savings by end use in Idaho. Similar to Washington, HVAC end uses (cooling, space heating, and ventilation) paired with interior lighting account for a substantial portion of the savings throughout the forecast horizon.

Figure 5-11 Commercial Cumulative Achievable Technical Potential by End Use, Idaho

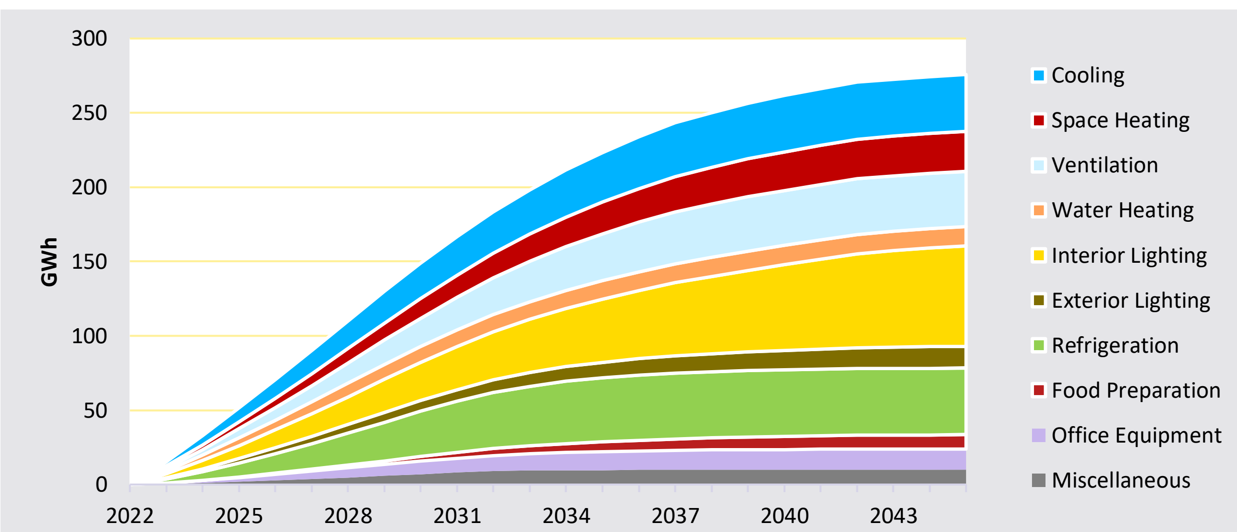


Table 5-11 identifies the top 20 commercial-sector measures from the perspective of annual energy savings in 2024 in Idaho. Ductless mini split heat pump is the number one measure in Idaho. In both states, linear lighting is included in the top 3 measures. Whole building measures such as Retrocommissioning and Strategic Energy Management contribute a significant portion to the potential.

Table 5-11 Commercial Top Measures in 2024, Idaho

Rank	Commercial Measure	2024 Cumulative Energy Savings (MWh)	% of Total
1	Ductless Mini Split Heat Pump	5,176	16%
2	Linear Lighting	4,124	13%
3	Retrocommissioning	2,445	7%
4	Strategic Energy Management	1,866	6%
5	HVAC - Dedicated Outdoor Air System (DOAS)	1,115	3%
6	Ventilation - Demand Controlled	1,011	3%
7	Refrigeration - High Efficiency Compressor	951	3%
8	Water Heater – Drain water Heat Recovery	939	3%
9	Refrigeration - Floating Head Pressure	827	3%
10	Engine Block Heater Controls	818	2%
11	Chiller - Chilled Water Reset	782	2%
12	Water Heater - Pipe Insulation	722	2%
13	Exterior Lighting - Photovoltaic Installation	664	2%
14	High-Bay Lighting	641	2%
15	Ventilation - Permanent Magnet Synchronous Fan Motor	552	2%
16	Water Heater - Motion Control Faucet	532	2%
17	Chiller - Thermal Energy Storage	470	1%
18	Water Heater - Solar System	460	1%
19	Desktop Computer	448	1%
20	General Service Lighting	428	1%
	Total of Top 20 Measures	**24,970**	**76%**
	Total Cumulative Savings	**32,835**	**100%**

Industrial Conservation Potential

Table 5-12 and Table 5-13 present state-specific estimates for the two levels of conservation potential for the industrial sector. For Washington, Achievable Technical Potential in the first year, 2023, is 5 GWh, or 0.9% of the baseline projection. In 2045, savings reach 85 GWh or 16.0% of the baseline projection. For Idaho, Achievable Technical Potential in the first year, 2023, is 4 GWh or 0.9% of the baseline projection. In 2045, savings reach 56 GWh or 17.7% of the baseline projection.

Table 5-12 Industrial Conservation Potential, Washington

	2023	2024	2025	2035	2045
Baseline projection (GWh)	565	565	561	544	534
Cumulative Savings (GWh)					
Achievable Technical Potential	5	10	16	72	85
Technical Potential	7	14	21	88	104
Cumulative Savings (aMW)					
Achievable Technical Potential	1	1	2	8	10
Technical Potential	1	2	2	10	12
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	0.9%	1.8%	2.9%	13.2%	16.0%
Technical Potential	1.2%	2.4%	3.8%	16.2%	19.5%

Table 5-13 Industrial Conservation Potential, Idaho

	2023	2024	2025	2035	2045
Baseline Projection (GWh)	398	394	391	350	316
Cumulative Savings (GWh)					
Achievable Technical Potential	4	7	12	49	56
Technical Potential	5	10	15	63	74
Cumulative Savings (aMW)					
Achievable Technical Potential	0	1	1	6	6
Technical Potential	1	1	2	7	8
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	0.9%	1.9%	2.9%	13.9%	17.7%
Technical Potential	1.2%	2.5%	4.0%	18.0%	23.3%

Figure 5-12 Industrial Cumulative Conservation Potential as a % of the Baseline Projection, Washington

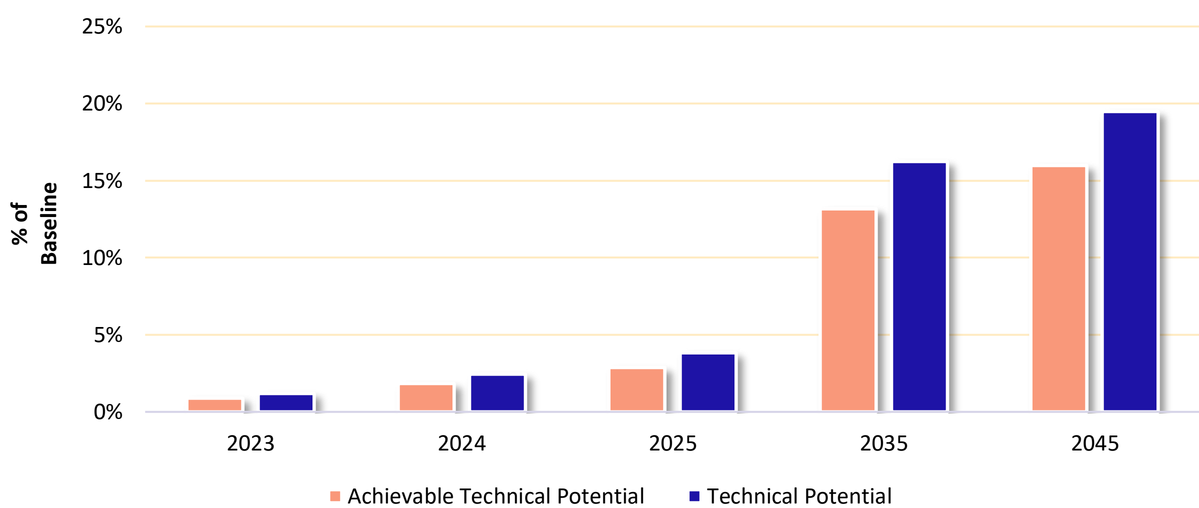


Figure 5-13 Industrial Cumulative Conservation Potential as a % of the Baseline Projection, Idaho

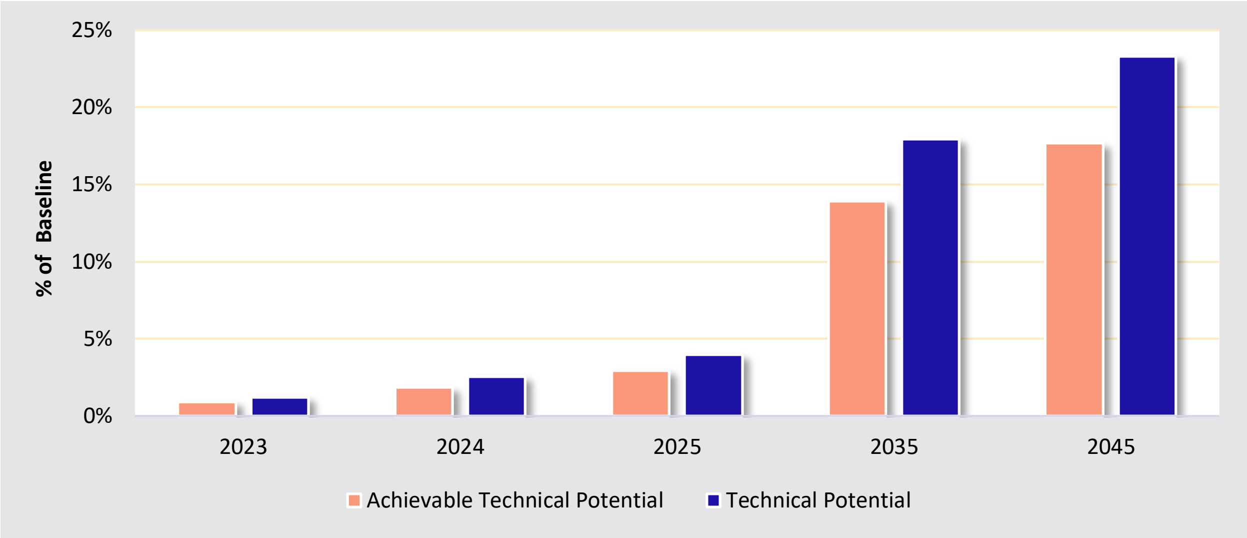


Figure 5-14 presents a forecast of cumulative industrial energy savings by end use in Washington. The motor and lighting end uses make up most of the savings potential in the study horizon.

Figure 5-14 Industrial Cumulative Achievable Technical Potential by End Use, Washington

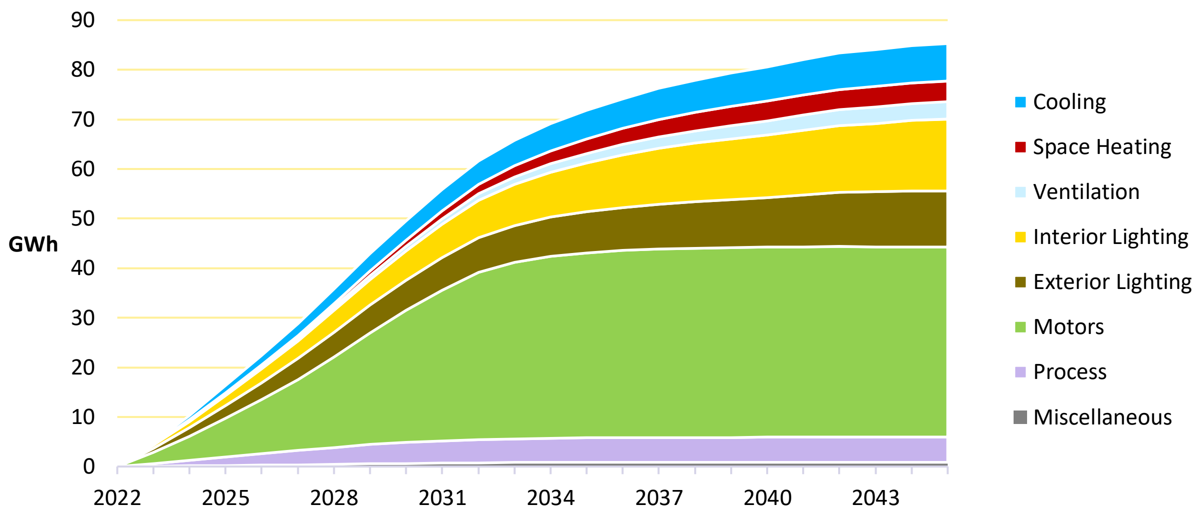


Table 5-14 identifies the top 20 industrial measures from the perspective of annual energy savings in 2024. In Washington, the top measure is linear lighting, which includes savings for network embedded controls. The measure with the second highest savings is pumping system – system optimization, which is the bi-product of the baseline consumption of pumping systems. Retrocommissioning, which targets multiple end uses, rounds out the top three.

Table 5-14 Industrial Top Measures in 2024, Washington

Rank	Measure	2024 Cumulative Energy Savings (MWh)	% of Total
1	Linear Lighting	981	10%
2	Pumping System - System Optimization	878	9%
3	Retrocommissioning	838	8%
4	Exterior Lighting - Photovoltaic Installation	616	6%
5	Strategic Energy Management	590	6%
6	Fan System - Flow Optimization	532	5%
7	High-Bay Lighting	530	5%
8	Fan System - Equipment Upgrade	523	5%
9	Pumping System - Variable Speed Drive	469	5%
10	Process - Tank Insulation	427	4%
11	Exterior Lighting - Retrofit - Enhanced Controls	370	4%
12	Pumping System - Equipment Upgrade	356	3%
13	Material Handling - Variable Speed Drive	300	3%
14	Compressed Air - End Use Optimization	257	2%
15	Destratification Fans (HVLS)	233	2%
16	Refrigeration - High Efficiency Compressor	229	2%
17	Chiller - Chilled Water Reset	205	2%
18	General Service Lighting	198	2%
19	Chiller - Variable Speed Fans	187	2%
20	Advanced Industrial Motors	184	2%
	Total of Top 20 Measures	**8,901**	**86%**
	Total Cumulative Savings	**10,317**	**100%**

Figure 5-15 presents a forecast of cumulative industrial energy savings by end use in Idaho. Similar to Washington, the motor and lighting end uses make up most of the savings' potential in the study horizon.

Figure 5-15 Industrial Cumulative Achievable Technical Potential by End Use, Idaho

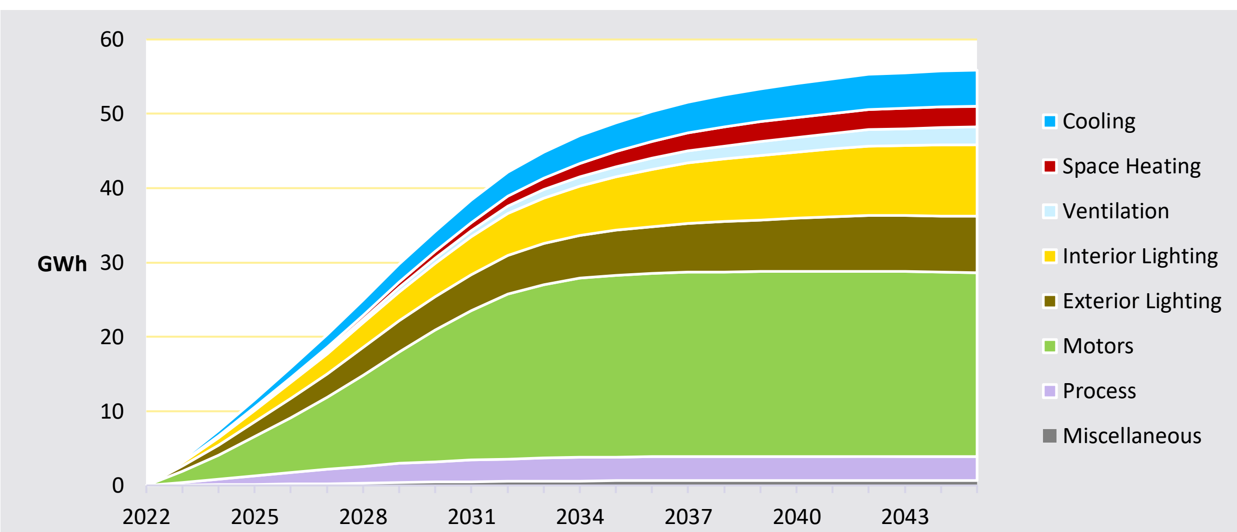


Table 5-15 identifies the top 20 industrial measures from the perspective of annual energy savings in 2024 in Idaho. Similar to Washington, the top three measures are linear lighting, pumping system – system optimization and Retrocommissioning.

Table 5-15 Industrial Top Measures in 2024, Idaho

Rank	Measure	2024 Cumulative Energy Savings (MWh)	% of Total
1	Linear Lighting	775	11%
2	Retrocommissioning	629	9%
3	Pumping System - System Optimization	541	7%
4	Exterior Lighting - Photovoltaic Installation	447	6%
5	High-Bay Lighting	424	6%
6	Strategic Energy Management	414	6%
7	Fan System - Flow Optimization	391	5%
8	Fan System - Equipment Upgrade	384	5%
9	Pumping System - Variable Speed Drive	289	4%
10	Exterior Lighting - Retrofit - Enhanced Controls	276	4%
11	Process - Tank Insulation	238	3%
12	Material Handling - Variable Speed Drive	220	3%
13	Pumping System - Equipment Upgrade	219	3%
14	Destratification Fans (HVLS)	195	3%
15	Compressed Air - End Use Optimization	175	2%
16	Refrigeration - High Efficiency Compressor	169	2%
17	General Service Lighting	155	2%
18	Chiller - Chilled Water Reset	152	2%
19	Chiller - Variable Speed Fans	138	2%
20	Advanced Industrial Motors	125	2%
	Total of Top 20 Measures	**6,358**	**87%**
	Total Cumulative Savings	**7,346**	**100%**

6 | DEMAND RESPONSE POTENTIAL

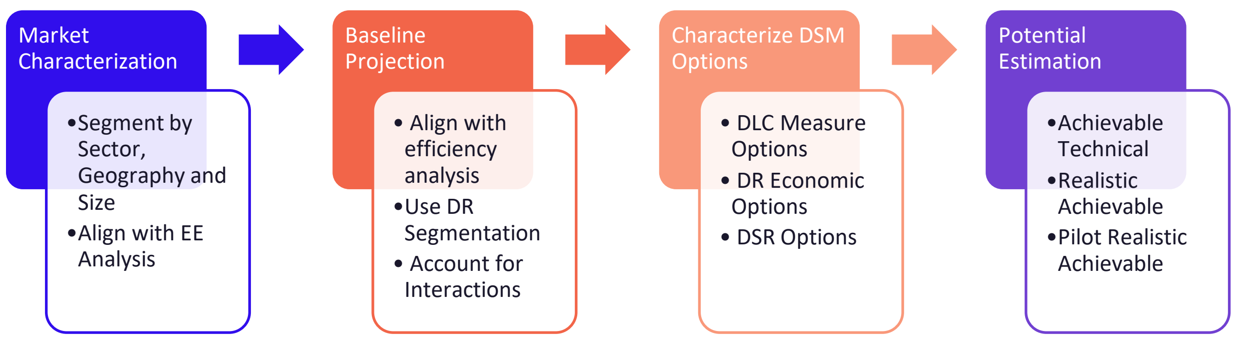
AEG has been working with Avista to estimate demand response (DR) potential since 2014. During that first study, AEG and The Brattle Group assessed winter demand response potential for Avista's C&I sectors in Washington and Idaho. Since then, AEG has performed four additional DR potential assessments including the current study expanding the scope and making improvements along the way as additional DR programs are run around the country.[5] For the current study, along with updating program potential performed in the previous studies, AEG assessed a set of pilot programs based on Avista's planned demand response program roll-out beginning in 2024.

The current study provides demand response potential and cost estimates for the 23-year planning horizon (2023-2045) to inform the development of Avista's 2023 IRP. Through this assessment, AEG sought to develop reliable estimates of the magnitude, timing, and costs of DR resources likely available to Avista over the 23-year planning horizon. The analysis focuses on resources assumed achievable during the planning horizon, recognizing known market dynamics that may hinder resource acquisition. DR analysis results will also be incorporated into subsequent DR planning and program development efforts.

Study Approach

Figure 6-1 outlines the analysis approach used to develop potential and cost estimates, with each step described in more detail in the subsections that follow.

Figure 6-1 Demand Response Analysis Approach



AEG estimated demand response potential across the following scenarios:

- **Achievable Technical Potential or Stand Alone**. In this scenario, program options are treated as if they are the only programs running in the Avista territory and are viewed in a vacuum. Potential demand savings cannot be added in this scenario since it does not account for program overlap.
- **Achievable Potential or Integrated.** In this scenario, the program options are treated as if the programs were run simultaneously. To account for participation overlap across programs that make use of the same end-use, a program hierarchy is employed. For programs that affect the same end use, the model selects the most likely program a customer would participate in, and eligible participants were chosen for that program first. The remaining pool of eligible participants will then be available to participate in the secondary program. This scenario allows for potential to be added up as it removes any double counting of savings.
- **Achievable Potential or Pilot Offerings.** In this scenario, AEG utilized the latest information from Avista regarding upcoming pilot offerings and expected program participation to forecast the first three years of each program. Avista plans to offer three new pilot programs beginning in 2024: Peak Time Rebate, Time-

[5] Since the 2014 study, AEG has expanded the study to include potential for the residential sector, summer, and an assessment of ancillary services for each program.

of-Use Opt-in, and Grid-Interactive Water Heaters. AEG forecasted the potential for these programs to 2045 as if the programs ramped up to fully-fledged programs after the pilots.

Market Characterization

The first step in the DR analysis was to segment customers by service class and develop characteristics for each segment. The two relevant characteristics for DR potential analysis are end-use saturations of the controllable equipment types in each market segment and coincident peak demand in the base year. Market characteristics, including equipment saturation and base year peak consumption, are consistent with the energy efficiency analysis (see Chapter 2 for more information on the market profiles).

As in previous studies, AEG used Avista's rate schedules as the basis for customer segmentation by state and customer class. Table 6-1 summarizes the market segmentation developed for this study.

Table 6-1 Market Segmentation

Market Dimensions	Segmentation Variable	Description
1	State	Idaho Washington
2	Customer Class (by rate schedule)	Residential Service General Service: Rate Schedule 11 Large General Service: Rate Schedule 21 Extra Large General Service: Rate Schedule 25[6]

AEG excluded Avista's two largest industrial customers from the analysis because they are so large and unique that a segment-based modeling approach is not appropriate. To accurately estimate DR potential for these customers, we would need to develop a detailed understanding of their industrial processes and associated possibilities for load reduction. We would also need to develop specific DR potential estimates for each customer. Avista may wish to engage these large customers directly to gauge interest in participating in DR programs.

Baseline Forecast

Once the customer segments were defined and characterized, AEG developed the baseline projection. Load and consumption characteristics, including customer count and coincident peak demand values, were provided by Avista load forecasts and aligned with the energy efficiency analysis.

Customer Counts

Avista provided actual customer counts by rate schedule for Washington and Idaho over the 2018-2020 timeframe and forecasted customer counts over the 2021-2026 period. AEG used this data to calculate the growth rates by customer class across the final two forecasted years, and projected customer counts through 2045. The average annual customer growth rate for all sectors is 1.1% in Washington and 1.5% in Idaho.

Table 6-2 and Table 6-3 show the number of customers by state and customer class for selected years.

Table 6-2 Baseline Customer Forecast by Customer Class, Washington

Customer Class	2023	2024	2025	2035	2045
Residential	120,160	123,096	124,664	140,976	159,476
General Service	16,976	17,214	17,421	19,573	21,992
Large General Service	858	849	846	827	817
Extra Large General Service	120,160	123,096	124,664	140,976	159,476

[6] Excluding the two largest Schedule 25 and Schedule 25P customers.

Table 6-3 Baseline Customer Forecast by Customer Class, Idaho

Customer Class	2023	2024	2025	2035	2045
Residential	234,506	238,867	241,392	264,323	289,812
General Service	23,539	23,825	24,095	26,542	29,226
Large General Service	1,772	1,767	1,764	1,745	1,730
Extra Large General Service	22	21	21	21	21

Summer and Winter Peak Load Forecasts by State

Summer and winter peak loads forecasts were developed by state, first by developing a growth rate utilizing forecasted electricity sales data provided from Avista for 2025 and 2026. The growth rate was applied to Avista's system winter and summer peaks for 2020 to develop a forecast by state and sector through 2045. Next, AEG developed the coincidence peak forecast for each segment utilizing load factors from Avista's 2010 load research study. The load factors were applied to 2020 actual electricity sales data to derive coincident peak demand estimates for the four customer classes. Finally, AEG used Avista's peak demand data to develop the individual state contribution to the estimated coincident peak values. These represent each state's projected demand at the time of the system peak for both summer and winter.[7]

Table 6-4 and Table 6-5 show the summer and winter system peak for selected future years.[8] The summer and winter system peaks are expected to increase by 33% and 24% respectively, between 2023-2045.

Table 6-4 Baseline July Summer System Peak Load (MW @Generation) by State

State	2023	2024	2025	2035	2045
Idaho	464	465	467	509	615
Washington	940	943	948	1,040	1,249
Summer Total	**1,404**	**1,408**	**1,415**	**1,548**	**1,864**

Table 6-5 Baseline February Winter System Peak Forecast (MW @Generation) by State

State	2023	2024	2025	2035	2045
Idaho	455	456	462	481	562
Washington	910	913	927	969	1,131
Winter Total	**1,365**	**1,369**	**1,389**	**1,450**	**1,693**

Figure 6-2 shows the state contribution to the estimated system coincident summer peak. In 2023, system peak load for the summer is 1,404 MW at the grid or generator level. Washington contributes 67% to the summer system peak, while Idaho contributes 33%. Summer coincident peak load is expected to grow by an average of 1.5% annually from 2022-2044.

[7] The month of July at hour ending 17 was used for the summer peak while February at hour ending 08 was used for the winter peak.

[8] As previously noted, these peaks exclude the demand for Avista's largest industrial customers.

Figure 6-2 Coincident Peak Load Forecast by State (Summer)

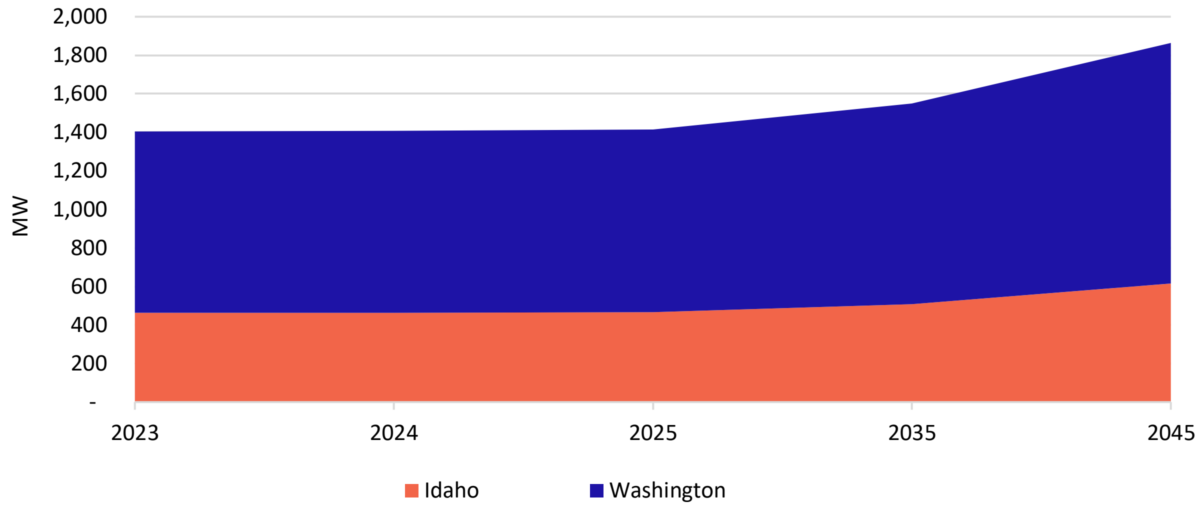
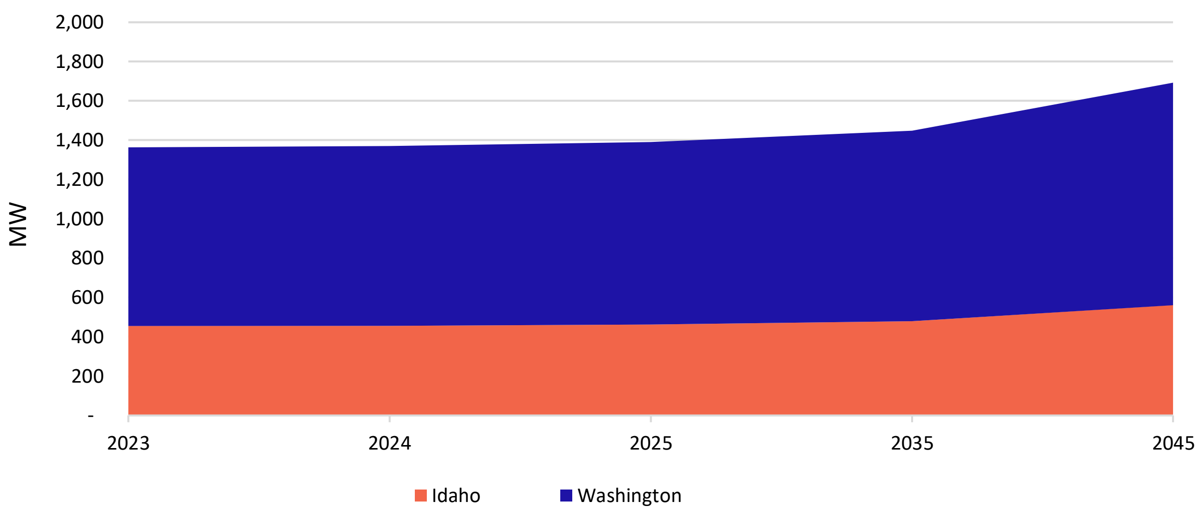


Figure 6-3 shows the state contribution to the estimated system coincident winter peak forecast. In 2023, system peak load for the winter is 1,365 MW at the grid or generator level. The winter system peak is about 3% lower than the summer peak. Like in summer, Washington contributes 67% to the winter system peak, while Idaho contributes 33%. Over the study period, winter coincident peak load is expected to grow by an average of 1.09% annually.

Figure 6-3 Coincident Peak Load Forecast by State (Winter)



Characterize Demand Response Program Options

Next, AEG identified and described the viable DR programs for inclusion in the analysis and developed assumptions for key program parameters, including per customer impacts, participation rates, program eligibility, and program costs. AEG considered the characteristics and applicability of a comprehensive list of options available that could be feasibly run in Avista's territory. Once a list of DR options was determined, AEG characterized each option. Several options could also have an ancillary component depending on the end use and if they could be used as a fast DR tool.[9]

Each selected option is described briefly below.

Program Descriptions

Direct Load Control of Central Air Conditioners

The Direct Load Control (DLC) of Central Air Conditioners (Central AC) targets Avista's Residential and General Service customers with qualifying equipment in Washington and Idaho. This program directly controls Central AC load in summer through a load control switch placed on a customer's air conditioning unit. During events, the Central AC units are cycled on and off. Participation is expected to be shared with the Smart Thermostats DLC-Cooling program in the integrated scenario since the programs target the same end-use technology.

DLC Smart Thermostats - Heating/Cooling

These programs use the two-way communicating ability of smart thermostats to cycle heating and cooling end uses on and off during events. The programs target Avista's Residential and General Service customers with qualifying equipment in Washington and Idaho. This program was assumed to be Bring Your Own Thermostat (BYOT); therefore, no equipment or installation costs were estimated. The cooling and heating programs are modeled separately because the impact assumptions are quite different; however, the heating program is assumed to piggyback off the cooling program.[10] Therefore, development and administrative costs were estimated only for the cooling program. In addition, the participation in the heating program was a subset of the cooling program participants based on typical heating program participation rates.

CTA-2045 Grid Interactive Water Heater

The CTA-2045 Grid Interactive Water Heater program targets Avista's Residential and General Service customers in Washington. These water heaters contain a communicating module interface and can seamlessly fit into a DR program as these become more prevalent in the Avista territory. Idaho is not mandating this equipment yet; therefore, this program is only modeled for Washington. Water heaters would be completely turned off during the DR event period. Water heaters of all sizes are eligible for control. A $150 cost to Avista is expected for each module with an additional provisioning cost of $100 for each customer (since only 20% of customers will need help provisioning, a $20 average provisioning cost is applied.) To provide additional granularity, AEG broke out the participation in this program across electric resistance and heat pump water heaters in the state of Washington, according to the latest saturation surveys used in the energy efficiency study. Results are presented separately in this study across the two end-use types. This program is planned to be offered as a pilot starting in 2024 and is included in the pilot section of this report.

DLC Water Heating

Because the Grid Interactive Water Heater program is only available in Washington, the DLC Water Heater program targets Avista's Residential and General Service customers in Idaho. This program directly controls water heating load throughout the year for these customers through a load control switch. Water heaters would be completely turned off during the DR event period. The event period is assumed to be 50 hours during the summer months and another 50 hours during the winter months. Water heaters of all sizes are eligible for control. AEG assumes a $160 cost to Avista for each switch, a $200 installation fee, and a permit and license cost of $100 for residential participants ($125 for general service participants).

DLC Smart Appliances

The DLC Smart Appliances program uses a wi-fi hub to connect smart wi-fi enabled appliances such as washers, dryers, refrigerators, and water heaters. During events throughout the year, the smart appliances are cycled on

[9] For those programs, ancillary services potential was also estimated and is presented in Appendix D.

[10] Since the cooling program is bearing the brunt of the costs of the whole BYOT program, the levelized costs presented in the appendix reflect very small costs for the heating portion of the program and relatively large costs for the cooling portion

and off. The program targets Avista's Residential and General Service customers in Washington and Idaho. A low steady-state participation rate of 5% is assumed for this program.

Third Party Contracts

Third Party Contracts are assumed to be available for General Service, Large General Service, and Extra Large General Service customers year-round. For the Large and Extra Large General Service customers, AEG assumes they will engage in firm curtailment. It is also assumed that participating customers will agree to reduce demand by a specific amount or curtail their consumption to a predefined level at the time of an event. In return, they receive a fixed incentive payment in the form of capacity credits or reservation payments (typically expressed as $/kW-month or $/kW-year). Customers are paid to be on call even though actual load curtailments may not occur. The amount of the capacity payment typically varies with the load commitment level. In addition to the fixed capacity payment, participants typically receive a payment for energy reduction during events. Because it is a firm, contractual arrangement for a specific level of load reduction, enrolled loads represent a firm resource and can be counted toward installed capacity requirements. Penalties may be assessed for under-performance or non-performance. Events may be called on a day-of or day-ahead basis as conditions warrant.

This option is typically delivered by load aggregators and is most attractive for customers with a maximum demand greater than 200 kW and flexibility in their operations. Industry experience indicates that aggregation of customers with smaller-sized loads is less attractive financially due to lower economies of scale. In addition, customers with 24x7 operations, continuous processes, or with obligations to continue providing service (such as schools and hospitals) are not often good candidates for this option.

For general service customers, AEG simulated a demand buyback program. In a demand buyback program, customers volunteer to reduce what they can on a day-ahead or day-of basis during a predefined event window. Customers then receive an energy payment based on their performance during the events.

DLC Electric Vehicle Charging

DLC Electric Vehicles Smart Chargers can be switched off during on-peak hours throughout the year to offset demand to off-peak hours. Avista currently has an Electric Vehicle Supply Equipment (EVSE) program in place for residential, commercial electric vehicle fleets, and workplace charging locations. AEG used the most recent per-customer program impacts from the EVSE program results for the study, assuming that, on average, 75% of electric vehicle load could be curtailed. Avista requested that this program be viewed as a fully-fledged program starting in 2024 to reflect the technology rollout. An EVSE rebate will be incentivized at a cost of $500[11] to Avista. An electric vehicle forecast was provided to AEG and provided the basis for estimating per-customer EV loads for this program, as well as the number of customers who could participate in an electric vehicle program.

Electric Vehicle Time-of-Use

There is currently an Electric Vehicle Time-of-Use (TOU) program being run in Avista's territory. This program had limited marketing and is currently only being utilized by a few companies totaling five vehicles in the General Service and Large General Service customer classes. The forecasted potential for the electric vehicle TOU program estimated in this study opens up this program to the full fleet of electric vehicles across the General Service and Large General Service classes according to the 2022 electric vehicle forecast provided by Avista and is presented as a new program beginning in 2024.

Time-of-Use Pricing

The TOU pricing rate is a standard rate structure where rates are lower during off-peak hours and higher during peak hours during the day, incentivizing participants to shift energy use to periods of lower grid stress. For the TOU rate, there are no events called, and the structure does not change during the year. Therefore, it is a good default rate for customers that still offers some load-shifting potential. We assume two scenarios for the TOU rate. An opt-in rate where participants will have to choose to go on the rate and an opt-out rate where participants will automatically be placed on the TOU rate and will need to request a rate change if required.

[11] Based on program values from Clark Public Utility, PSE Washington, and Tacoma Public Utility which all use $500 for their EVSE rebate

This rate is assumed to be available to all service classes. The TOU Opt-in program is planned to be offered as a pilot offering starting in 2024 and is included in the pilot section of this report.

Variable Peak Pricing

The Variable Peak Pricing (VPP) rate is composed of significantly higher prices during relatively short critical peak periods on event days to encourage customers to reduce their usage. VPP is usually offered in conjunction with a time-of-use rate, which implies at least three time periods: critical peak, on-peak and off-peak. The customer incentive is a more heavily discounted rate during off-peak hours throughout the year (relative a standard TOU rate). Event days are dispatched on relatively short notice (day ahead or day of), typically for a limited number of days during the year. Over time, event-trigger criteria become well-established so that customers can expect events based on hot weather or other factors. Events can also be called during times of system contingencies or emergencies. In past studies, this rate has been assumed to be offered to all service classes; however, with the addition of Peak Time Rebate this year, VPP will only be considered for large and extra-large Service customers.

Peak Time Rebate

The Peak Time Rebate (PTR) program offers participants an incentive for every kW saved during designated times of high energy demand. Events are called several times per season, and participants are given incentives in the form of $/kWh saved during the event relative to their baseline usage across previous seasons. The assumptions for this program were based primarily on the results of Portland General Electric’s PTR program and are offered to residential and general service customers, as not to overlap with the VPP program. In addition, PTR is planned to be offered as a pilot program starting in 2024 and is included in the pilot section of this report.

Ancillary Services

Ancillary services refer to functions that help grid operators maintain a reliable electricity system. Ancillary services maintain the proper flow and direction of electricity, address imbalances between supply and demand, and help the system recover after a power system event. In systems with significant variable renewable energy penetration, additional ancillary services may be required to manage increased variability and uncertainty. In addition, Ancillary Services can provide fast DR response during grid emergencies. AEG assumes ancillary service DR capabilities are available across all sectors. Ancillary Service options can be offered to customers who are already on programs with ancillary capabilities for an additional incentive. For this study, ancillary programs were modeled for several parent programs: Smart Thermostats- Heating/Cooling, DLC Water Heating, CTA-2045 Water Heating, Electric Vehicle Charging, and Battery Energy Storage. Ancillary service results are presented in Appendix D for the Integrated Opt-in scenario.

Thermal Energy Storage

Ice Energy Storage, a type of thermal energy storage, is an emerging technology that is being explored in many peak-shifting applications across the country. This technology involves cooling and freezing water in a storage container so that the energy can be used later for space cooling. More specifically, frozen water takes advantage of the large amount of latent energy associated with the phase change between ice and liquid water, which will absorb or release a large amount of thermal energy while maintaining a constant temperature at the freezing (or melting) point. An ice energy storage unit turns water into ice during off-peak times when price and demand for electricity are low, typically at night. During the day, at peak times, the stored ice is melted to meet all or some of the building’s cooling requirements, allowing air conditioners to operate at reduced loads.

Ice energy storage is primarily being used in non-residential buildings and applications, as modeled in this analysis, but may see expansion in the future to encompass smaller, residential systems as well as emerging grid services for peak shaving and renewable integration. Since the ice energy storage is used for space cooling, AEG assumes this program would be available during the summer months only.

Battery Energy Storage

This program provides the ability to shift peak loads using stored electrochemical energy. Currently, the main battery storage equipment uses lithium-ion batteries. They are the most cost-effective battery type on the market today. AEG assumes the battery energy storage option will be available for all service classes, with the size and cost of the battery varying depending on the level of demand of the building.

Behavioral DR

Behavioral DR is structured like traditional demand response interventions, but it does not rely on enabling technologies, nor does it offer financial incentives to participants. Participants are notified of an event and simply asked to reduce their consumption during the event window. Generally, notification occurs the day prior to the event and are deployed utilizing a phone call, email, or text message. The next day, customers may receive post-event feedback that includes personalized results and encouragement.

For this analysis, we assumed the Behavioral DR program would be offered as part of a Home Energy Reports program in a typical opt-out scenario. As such, we assume this program would be offered to residential customers only. Avista does not currently have a Home Energy Report program in place. Therefore, the Behavioral program is expected to bear the full cost of the program implementation.

Program Assumptions and Characteristics

The key parameters required to estimate the potential for a DR program are participation rate, per-participant load reduction, and eligibility or end use saturations.[12] The development of these parameters is based on research findings and a review of available information on the topic, including national program survey databases, evaluation studies, program reports, and regulatory filings. AEG's assumptions of these parameters are described below.

Participation Rate Assumptions

Table 6-6 below shows the steady-state participation rate assumptions for each demand side management (DSM) option as well as the basis for the assumptions. Participation for space cooling is split between DLC Central AC and Smart Thermostat options, so in total, they don't exceed 30%.[13]

[12] End Use Saturations used in this study are provided in Appendix D.

[13] NWPCC assumption of 30% participation for a space cooling DR program.

Table 6-6 Steady-State Participation Rate Assumptions (% of eligible customers)

DSM Option	Residential Service	General Service	Large General Service	Extra Large General Service	Basis for Assumption
DLC Central AC	10%	10%	-	-	NWPC DLC Switch cooling assumption
DLC Smart Thermostats - Heating	5%	3%	-	-	Piggybacks off cooling- Adjusted to reflect realistic participation for space heating
CTA-2045 Grid Interactive Water Heater (ER/HP)	50%	50%	-	-	NWPC Grid Interactive Water Heater Assumptions- Ten Year Ramp Rate
DLC Smart Thermostats - Cooling	20%	20%	-	-	NWPC Smart Thermostat cooling assumption
DLC Smart Appliances	5%	5%	-	-	2017 ISACA IT Risk Reward Barometer – US Consumer Results, October 2017
Third Party Contracts	-	15%	20%	20%	Industry Experience
DLC Electric Vehicle Charging	15%	-	-	-	1/3 of TOU opt-in participation rate (17% lowered to 15% based on Avista decision)
Time-of-Use Opt-in	13%	13%	13%	13%	Industry experience; Winter impacts ½ of summer impacts.
Time-of-Use Opt-out	74%	74%	74%	74%	
Electric Vehicle TOU Opt-in		51%	51%		Based on DTE program achieving 2500 EV enrollments in 3 years, with similar base EV population
Variable Peak Pricing			25%	25%	OG&E 2019 Smart Hours Study
Peak Time Rebate	15%	15%			2021 PGE Res Pricing and Behavioral Pilot Flex PTR Evaluation
Thermal Energy Storage	-	1%	2%	2%	Industry Experience
Battery Energy Storage	1%	1%	1%	1%	Industry Experience
Behavioral	20%	-	-	-	PG&E rollout with six waves (2017)

Load Reduction Assumptions

Table 6-7 presents the per participant load reductions for each DSM option and explains the basis for these assumptions. The load reductions are shown on a kW basis for technology-based options and a percent load reduction otherwise.

Table 6-7 DSM Per Participant Impact Assumptions

DSM Option	Residential	General Service	Large General Service	Extra Large General Service	Basis for Assumption
DLC Central AC	0.5 kW	1.25 kW	-	-	NWPC DLC Switch cooling assumption was close to 1.0 kW reduced to adjust for Avista proposed cycling strategy,
DLC Smart Thermostats - Heating	1.09 kW	1.35 kW	-	-	NWPC Smart thermostat heating assumption (east)
CTA-2045 Grid Interactive Water Heater (ER/HP)	ER: 0.35-0.37 kW HP: 0.9-0.22 kW	ER: 0.87 kW HP: 0.21 kW	-	-	BPA 2018 Peak Mitigation (ER/HP)
DLC Smart Thermostats - Cooling	0.50 kW	1.25 kW	-	-	NWPC DLC Switch cooling assumption was close to 1.0 kW reduced to adjust for Avista proposed cycling strategy
DLC Smart Appliances	0.14 kW	0.14 kW	-	-	Ghatikar, Rish. Demand Response Automation in Appliance and Equipment. Lawrence Berkley National Laboratory, 2017.
Third Party Contracts	-	10%	21%	21%	2012 Statewide Load Impact Evaluation of California Aggregator Demand Response Programs Volume 1: Ex post and Ex ante Load Impacts; Christensen Associates Energy Consulting; April 1, 2013
DLC Electric Vehicle Charging	0.54 kW	-	-	-	75% of Avista Light-Duty Vehicle Average Load
Time-of-Use Opt-in	6%	0%	3%	3%	Best estimate based on industry experience; Winter impacts ½ of summer impacts
Time-of-Use Opt-out	3%	0%	3%	3%	
Electric Vehicle TOU Opt-in		7%	7%		Brattle Analysis and Estimate, based on DTE rate differential of 2.5
Variable Peak Pricing	10%	4%	4%	4%	OG&E 2019 Smart Hours Study; Summer Impacts Shown (Winter impacts ¾ summer)
Peak Time Rebate	7.1% (W) 8.2% (S)	3.6% (W) 4.1% (S)			PGE Res Pricing and Behavioral Pilot Flex PTR Evaluation 2021: 0.159 or 8.2% in summer, 0.134 or 7.1% in winter
Thermal Energy Storage		1.68 kW	8.4 kW	8.4 kW	2016 Ice Bear Tech Specifications
Battery Energy Storage	2 kW	2 kW	15 kW	15 kW	Typical Battery size per segment
Behavioral	2%	-	-	-	Opower documentation for BDR with Consumers and Detroit Energy

Other Cross-cutting Assumptions

In addition to the above program-specific assumptions, there are three that affect all programs:

- **Discount rate.** A nominal discount rate of 5.21% was used to calculate the net present value of costs over the useful life of each DR program. All cost results are shown in nominal dollars.
- **Line losses.** Avista provided a line loss factor of 6.16% to convert estimated demand savings at the customer meter level to the generator level. Results in the next section are reported at the generator level.
- **Shifting and Saving.** Each program varies in the way energy is shifted or saved throughout the day. For example, customers on the DLC Central AC program are likely to pre-cool their homes prior to the event and turn their AC units back on after the event (snapback effect). The results in this report only show the savings during the event window and not before and after the event. However, shifting and savings assumptions were provided to Avista for each program to inform the IRP results.

Integrated DR Potential Results

This section presents analysis results for demand savings and levelized costs for all considered DR programs. In the interest of succinctness, AEG only presents the Integrated TOU Opt-in scenario results in this chapter. The integrated approach represents Realistic Achievable Potential and is the most realistic scenario allowing for multiple DR programs to be run at the same time employing a hierarchy that eliminates double counting of impacts. Integrated TOU opt-out and stand-alone scenario (Achievable Technical Potential) results can be found in Appendix D.

All potential results represent savings at the generator.[14] The following sections separate out the integrated potential results for the summer and winter seasons.

Summary TOU Opt-in Scenario

Table 6-8, Table 6-9, and Figure 6-4 show the total summer and winter demand savings for selected years. These savings represent integrated savings from all available DR options in Avista's Washington and Idaho service territories.

- **Summer TOU Opt-In Scenario.** Total potential savings are expected to increase from 0.3 MW in 2023 to 149 MW by 2045. The percentage of system peak increases from 0% in 2023 to 8.0% by 2045.
- **Winter TOU Opt-In Scenario.** The total potential savings are expected to increase from 0.03 MW in 2023 to 111 MW by 2045. The percentage of system peak goes from 0% in 2022 to 6.1% by 2045.

Table 6-8 Summary of Integrated TOU Opt-In Potential (MW @ Generator), Summer

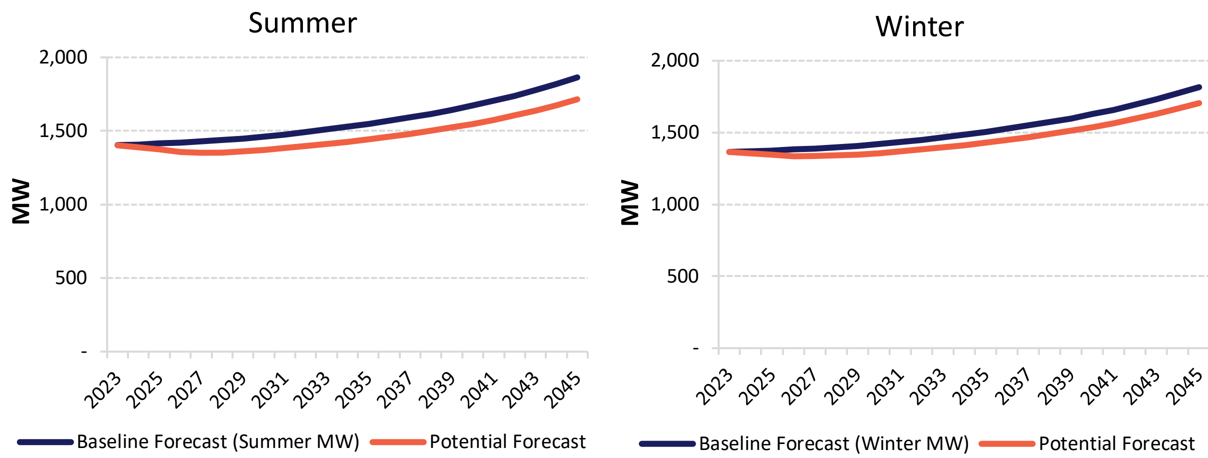
	2023	2024	2025	2035	2045
Baseline Forecast (MW)	1,404	1,408	1,415	1,548	1,864
Achievable Potential (MW)	0	18	39	105	149
Achievable Potential (% of baseline)	0.0%	1.3%	2.8%	6.8%	8.0%
Potential Forecast	1,404	1,390	1,376	1,443	1,715

Table 6-9 Summary of Integrated TOU Opt-In Potential (MW @ Generator), Winter

	2023	2024	2025	2035	2045
Baseline Forecast (MW)	1,365	1,369	1,376	1,505	1,816
Achievable Potential (MW)	0	15	31	75	111
Achievable Potential (% of baseline)	0.0%	1.1%	2.2%	5.0%	6.1%
Potential Forecast	1,365	1,354	1,345	1,430	1,705

[14] Line losses were applied to all savings potential as well as demand forecasts to present the results in terms of generation as opposed to meter.

Figure 6-4 Summary of Integrated TOU Opt-In Potential (MW @ Generator)



Summer Opt-in TOU Scenario

Key findings from the summer integrated Opt-in TOU scenario include:

- DLC Smart Thermostats have the highest potential savings; they are expected to reach 30.7 MW by 2045.
- DLC Electric Vehicle Charging (29.3 MW) and Third Party Contracts (29.1 MW) have the next-highest potential savings, respectively.
- Most of the DR potential in both Washington and Idaho comes from the residential customer class.

Potential by DSM Option

Figure 6-5 and Table 6-10 show the summer demand savings from individual DR options. The savings represent integrated savings from all available DR options in Avista's Washington and Idaho service territories. Only the current EV TOU offering is set to begin in 2023. All other options begin in 2024.

Figure 6-5 Summary of Summer Potential by Option – TOU Opt-In (MW @ Generator)

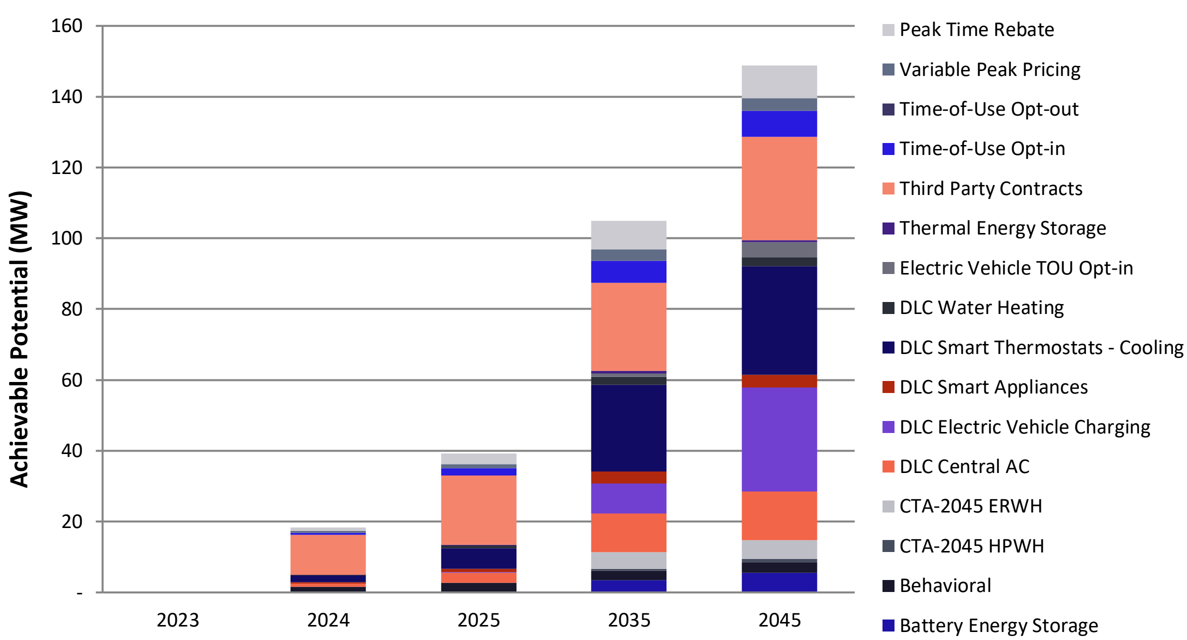


Table 6-10 Summary of Summer Potential by Option – TOU Opt-In (MW @ Generator)

	2023	2024	2025	2035	2045
Battery Energy Storage	-	0.1	0.2	3.4	5.5
Behavioral	-	1.4	2.5	2.7	3.0
CTA-2045 HPWH	-	0.0	0.0	0.6	1.0
CTA-2045 ERWH	-	0.0	0.1	4.6	5.3
DLC Central AC	-	0.9	2.9	11.1	13.7
DLC Electric Vehicle Charging	-	0.0	0.2	8.4	29.3
DLC Smart Appliances	-	0.3	0.9	3.3	3.7
DLC Smart Thermostats - Cooling	-	1.9	5.9	24.5	30.7
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	-	0.2	0.6	2.2	2.4
Electric Vehicle TOU Opt-in	0.0	0.1	0.1	1.0	4.2
Thermal Energy Storage	-	0.1	0.2	0.7	0.7
Third Party Contracts	-	11.2	19.5	24.9	29.1
Time-of-Use Opt-in	-	0.7	2.2	6.3	7.2
Variable Peak Pricing	-	0.4	1.1	3.2	3.7
Peak Time Rebate	-	1.0	3.1	8.0	9.2

Potential by Sector and Segment

Table 6-11 and Table 6-12 show the total summer demand savings by class for Washington and Idaho, respectively. Washington is projected to save 97 MW (7.7% of summer peak demand) by 2045, while Idaho is projected to save 52 MW (8.4% of summer peak demand) by 2045.

Table 6-11 Summer Potential by Class – TOU Opt-In (MW @ Generator), Washington

	2023	2024	2025	2035	2045
Baseline Forecast (MW)	**940**	**943**	**948**	**1,040**	**1,249**
Achievable Potential (MW)	**0**	**13**	**26**	**69**	**97**
Residential	-	4.1	10.6	41.9	59.2
General Service	0.0	1.3	2.5	8.8	15.6
Large General Service	0.0	5.8	9.6	13.8	16.3
Extra Large General Service	-	1.8	3.0	4.3	5.5

Table 6-12 Summer Potential by Class – TOU Opt-In (MW @ Generator), Idaho

	2023	2024	2025	2035	2045
Baseline Forecast (MW)	**464**	**465**	**467**	**509**	**615**
Achievable Potential (MW)	**0**	**5**	**14**	**36**	**52**
Residential	-	1.9	5.8	22.6	32.5
General Service	0.0	0.6	1.6	5.2	9.8
Large General Service	0.0	1.7	4.1	5.7	6.6
Extra Large General Service	-	1.2	2.0	2.8	3.3

Figure 6-6 Summer Potential by Class – TOU Opt-In (MW @Generator), Washington

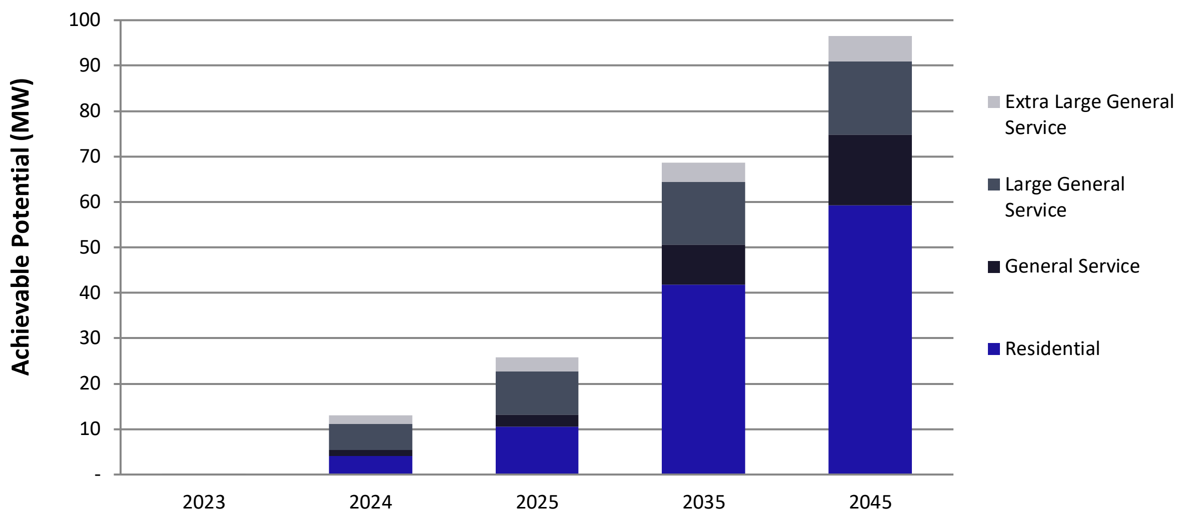
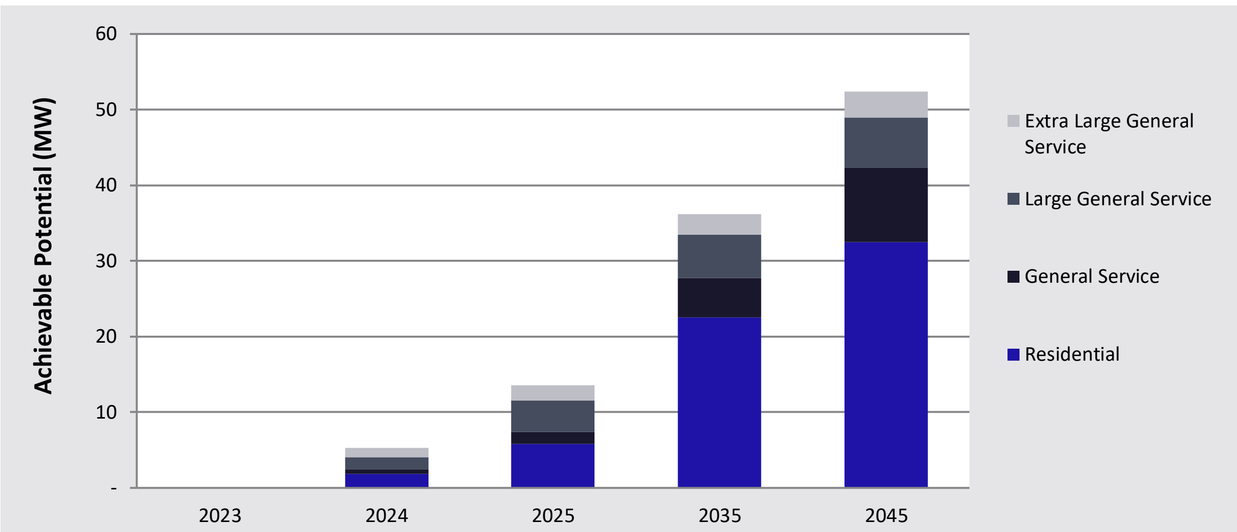


Figure 6-7 Summer Potential by Class – TOU Opt-In (MW @Generator), Idaho



Winter TOU Opt-in Scenario

Key findings from the winter integrated Opt-in TOU scenario include:

- The highest potential options are Third-Party Contracts (29.6 MW in 2045) and DLC Electric Vehicle Charging (29.3 MW in 2045).
- DLC Smart Thermostats have much lower potential savings for heating (5.8 MW by 2045) than cooling as the heating program will piggyback off the cooling program and be a subset of the cooling participants.
- In past years, Variable Peak Pricing has shown high potential savings in both summer and winter seasons. However, since Variable Peak Pricing is only being considered for large and extra-large customer classes in this study, the potential is much lower (3.7 MW by 2045)[15].

[15] The PTR Program is modeled to target residential and general service customers

Potential by DSM Option

Figure 6-8 and Table 6-13 show the total winter demand savings from individual DR options for selected years. These savings represent integrated savings from all available DR options in Avista's Washington and Idaho service territories. The total potential savings in the Winter TOU Opt-in scenario are expected to increase from 0.03 MW in 2023 to 111 MW by 2045. The respective increase in the percentage of system peak goes from 0% in 2022 to 6.1% by 2045.

Figure 6-8 Summary of Winter Potential by Option – TOU Opt-In (MW @ Generator)

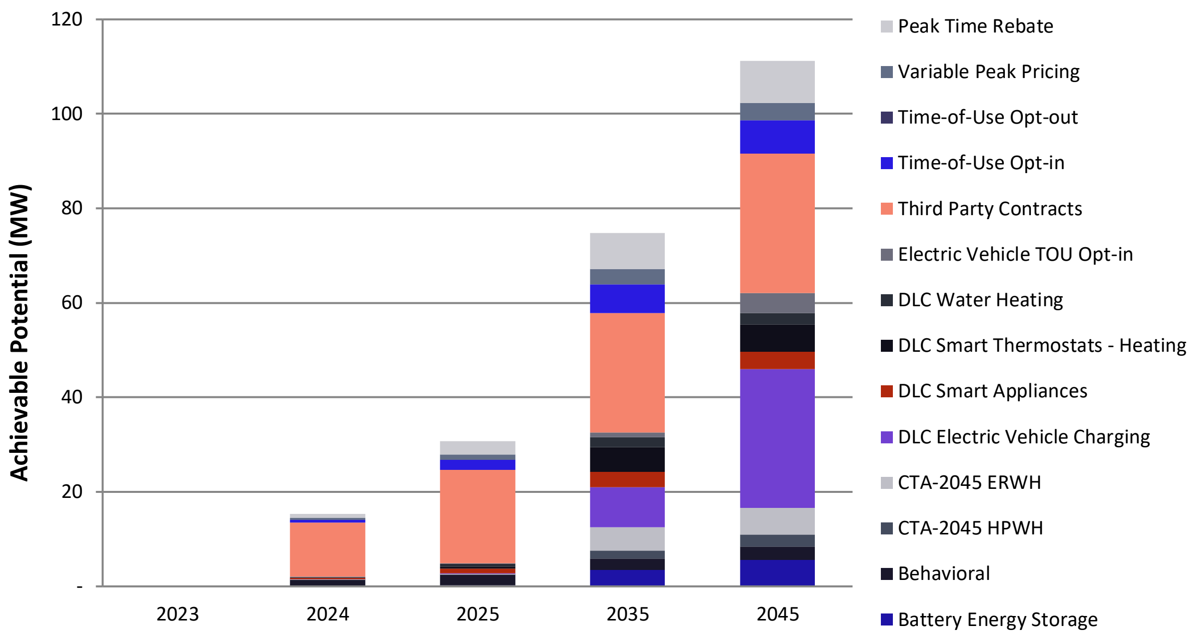


Table 6-13 Summary of Winter Potential by Option – TOU Opt-In (MW @ Generator)

	2023	2024	2025	2035	2045
Battery Energy Storage	-	0.1	0.2	3.4	5.5
Behavioral	-	1.3	2.3	2.5	2.9
CTA-2045 HPWH	-	0.0	0.0	1.6	2.6
CTA-2045 ERWH	-	0.0	0.1	5.0	5.7
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	0.0	0.2	8.4	29.3
DLC Smart Appliances	-	0.3	0.9	3.3	3.7
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	-	-	0.5	5.2	5.8
DLC Water Heating	-	0.2	0.6	2.2	2.4
Electric Vehicle TOU Opt-in	0.0	0.1	0.1	1.0	4.2
Thermal Energy Storage	-	-	-	-	-
Third Party Contracts	-	11.4	19.9	25.3	29.6
Time-of-Use Opt-in	-	0.6	2.1	6.1	7.0
Variable Peak Pricing	-	0.4	1.1	3.3	3.7
Peak Time Rebate	-	0.9	2.9	7.6	8.8

Potential by Sector and Segment

Table 6-14 and Table 6-15 show the total winter demand savings by class for Washington and Idaho, respectively. Washington is projected to save 74 MW (8.5% of winter system peak demand) by 2045, while Idaho is projected to save 38 MW (6.2% of winter system peak demand) by 2045.

Table 6-14 Winter Potential by Class – TOU Opt-In (MW @Generator), Washington

	2023	2024	2025	2035	2045
Baseline Forecast (Winter MW)	**910**	**913**	**918**	**1,006**	**1,212**
Achievable Potential (MW)	**0**	**11**	**20**	**50**	**74**
Residential	-	2.3	5.5	24.9	38.1
General Service	0.0	1.1	1.9	6.8	13.5
Large General Service	0.0	5.7	9.5	13.5	16.0
Extra Large General Service	-	2.0	3.4	4.8	6.0

Table 6-15 Winter Potential by Class – TOU Opt-In (MW @Generator), Idaho

	2023	2024	2025	2035	2045
Baseline Forecast (Winter MW)	**455**	**456**	**458**	**499**	**604**
Achievable Potential (MW)	**0**	**4**	**11**	**25**	**38**
Residential	-	0.9	3.2	12.6	19.4
General Service	0.0	0.5	1.2	3.7	8.2
Large General Service	0.0	1.7	4.1	5.6	6.6
Extra Large General Service	-	1.3	2.1	2.9	3.4

Figure 6-9 Winter Potential by Class – TOU Opt-In (MW @Generator), Washington

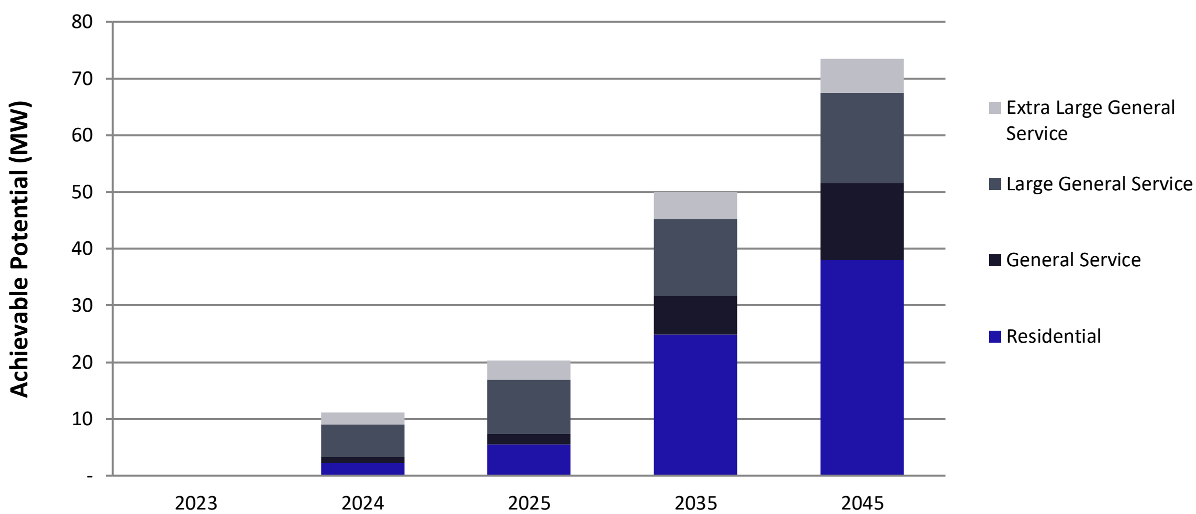
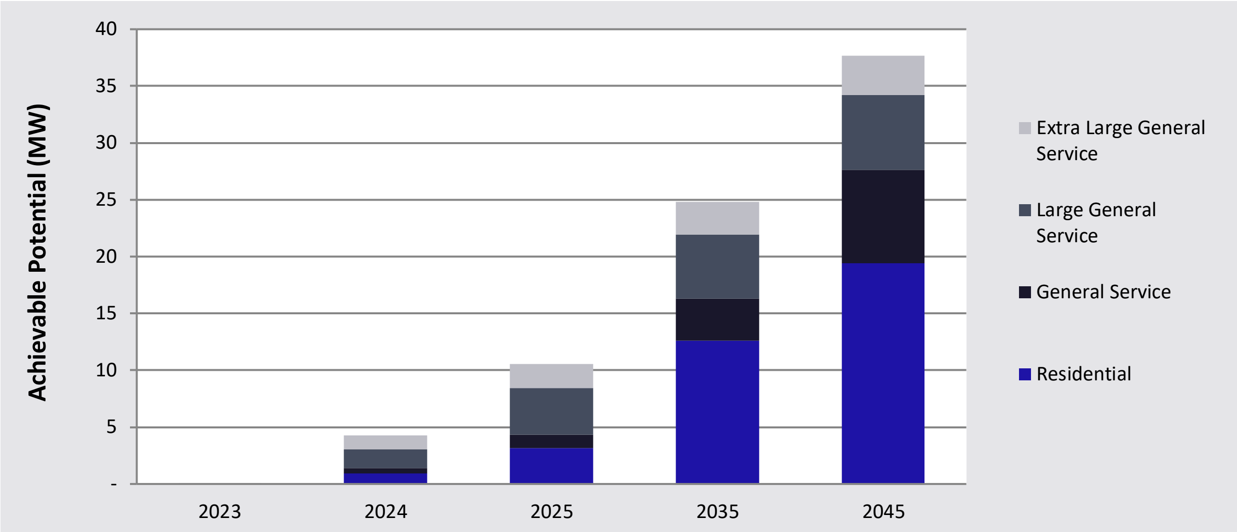


Figure 6-10 Winter Potential by Class – TOU Opt-In (MW @Generator), Idaho



Levelized Costs

Table 6-16 presents the levelized costs per kW of equivalent generation capacity over 2023-2032 for Washington and Idaho. The ten-year NPV MW potential by program is also shown for reference in the first two columns. Some options are only available in summer or winter, such as Thermal Energy Storage, Smart Thermostat programs, and DLC Cooling.

Key findings include:

- The Third Party Contracts option delivers the highest savings in 2031 at approximately $75.28/kW-year cost in winter and $76.70/kW-year cost in summer. Capacity-based and energy-based payments to the third-party constitutes the major cost component for this option. All O&M and administrative costs are expected to be incurred by the representative third-party contractor.
- The Variable Peak Pricing option has the lowest levelized cost among all the DR options. It delivers 19.20 MW of winter savings in 2031 at $37.80/kW-year system-wide and 18.77 MW of summer savings at $38.67/kW-year system-wide. Enabling technology purchase and installation costs for enhancing customer response is a large part of deployment costs.

Table 6-16 Levelized Program Costs and Potential (TOU Opt-In Winter)

Program	NPV Winter Potential MW	NPV Summer Potential MW	Winter Levelized Costs	Summer Levelized Costs
Battery Energy Storage	7.16	7.16	$863.37	$863.37
Behavioral	18.23	19.45	$145.50	$136.42
CTA-2045 HPWH	2.93	1.12	$1,001.06	$2,626.31
CTA-2045 ERWH	10.06	9.33	$557.55	$600.93
DLC Central AC		57.42		$160.23
DLC Electric Vehicle Charging	13.79	13.79	$907.76	$907.76
DLC Smart Appliances	18.26	18.26	$398.72	$398.72
DLC Smart Thermostats - Cooling		125.07		$135.30
DLC Smart Thermostats - Heating	24.39		$25.81	
DLC Water Heating	12.00	12.00	$622.13	$622.13
Electric Vehicle TOU Opt-in	1.73	1.73	$569.25	$569.25
Thermal Energy Storage		4.05		$879.99
Third Party Contracts	172.78	169.57	$75.28	$76.70
Time-of-Use Opt-in	36.11	37.77	$76.37	$73.01
Variable Peak Pricing	19.20	18.77	$37.80	$38.67
Peak Time Rebate	45.84	48.56	$56.09	$52.95

Pilot Program Potential Results- Washington

The following section presents the results of the pilot program scenario. Avista expects to implement three pilot programs in Washington beginning in 2024, TOU Opt-in, Peak Time Rebates[16], and Grid-interactive Water Heating. Each pilot will run for three years; the TOU Opt-in will have an optional two-year extension depending on results.[17] Each program will be offered to residential and general service customers only.

The potential results include the first three years of the pilot programs, then ramp up to a fully-fledged program for the remainder of the study horizon. The results of the Grid-Interactive Water Heater Program are split out by electric resistance and heat pump water heaters according to saturation levels in Washington.

Key findings include:

- By the end of the three-year pilot period, Grid-Interactive Water Heating presents the greatest potential savings, with the majority stemming from electric resistance water heaters. Combined, this program could reach nearly 0.2 MW in potential savings by 2026.
- Among rate options, TOU Opt-in is expected to achieve slightly higher potential at 0.13 MW savings by the end of the pilot period, while Peak Time Rebate is expected to reach just under 0.1 MW.

Summer Integrated Pilot Scenario

Figure 6-11 and Table 6-17 show the total summer demand savings from individual DR pilot options. These savings represent integrated savings from all available DR options in Avista's Washington service territory. Total potential savings for summer pilot programs are expected to increase from 0.1 MW in 2024 to 18.3 MW by 2045. Over the first three years of the pilot, the Grid-Interactive Water Heating Program is expected to have the most potential (0.2 MW by 2026), with the majority of the potential coming by way of electric resistance water heaters. Table 6-18 shows the total summer demand savings by class. The pilot programs are projected

[16] It should be noted that the results of the Peak Time Rebate potential reflect the impacts from a Portland General Electric pilot program which included significant customer education and feedback. However, other PTR programs (such as in California) achieved zero savings.

[17] Potential results for the TOU Opt-in Pilot do not include the two-year extension and are based on a three-year pilot.

to save 18.3 MW (1.5% of summer peak demand) by 2045, with most of the potential coming from the residential class.

Figure 6-11 Summary of Summer Potential by Option (Pilot MW @ Generator)

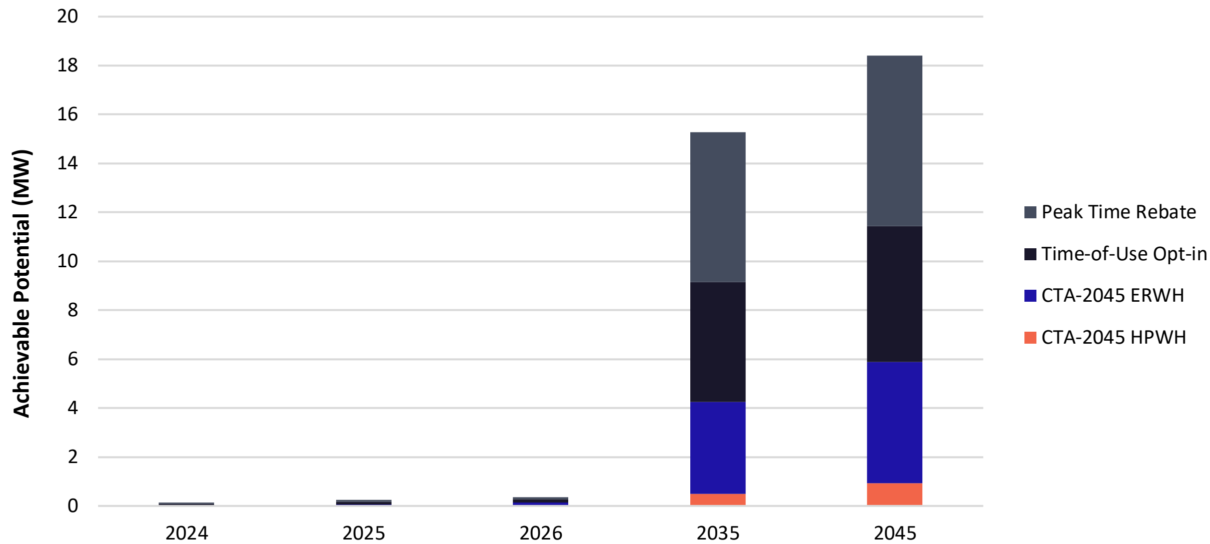


Table 6-17 Summary of Summer Potential by Option (Pilot MW @ Generator)

	2024	2025	2026	2035	2045
Baseline Forecast (MW)	**943**	**948**	**952**	**1,040**	**1,249**
Achievable Potential (MW)	**0.1**	**0.3**	**0.4**	**15.1**	**18.3**
CTA-2045 HPWH	0.0	0.0	0.0	0.5	1.0
CTA-2045 ERWH	0.0	0.1	0.2	4.0	5.3
Time-of-Use Opt-in	0.1	0.1	0.1	4.1	4.6
Peak Time Rebate	0.0	0.1	0.1	6.5	7.4

Table 6-18 Summer Potential by Class (Pilot MW @ Generator), Washington

	2024	2025	2026	2035	2045
Residential	0.1	0.2	0.4	13.5	16.2
General Service	0.0	0.0	0.0	1.6	2.1

Winter Integrated Pilot Scenario

Figure 6-12 and Table 6-19 show the total winter demand savings from individual DR pilot options. These savings represent integrated savings from all available DR options in Avista's Washington service territory. Total potential savings for winter pilot programs are expected to increase from 0.1 MW in 2024 to 19.6 MW by 2045. Over the first three years of the pilot, the Grid-Interactive Water Heating Program is expected to have the most potential (0.2 MW by 2026), with the majority of the potential coming by way of electric resistance water heaters. Table 6-20 shows the total winter demand savings by class. The pilot programs are projected to save 19.6 MW (1.6% of summer peak demand) by 2045, with most of the potential coming from the residential class.

Figure 6-12 Summary of Winter Potential by Option (Pilot MW @Generator)

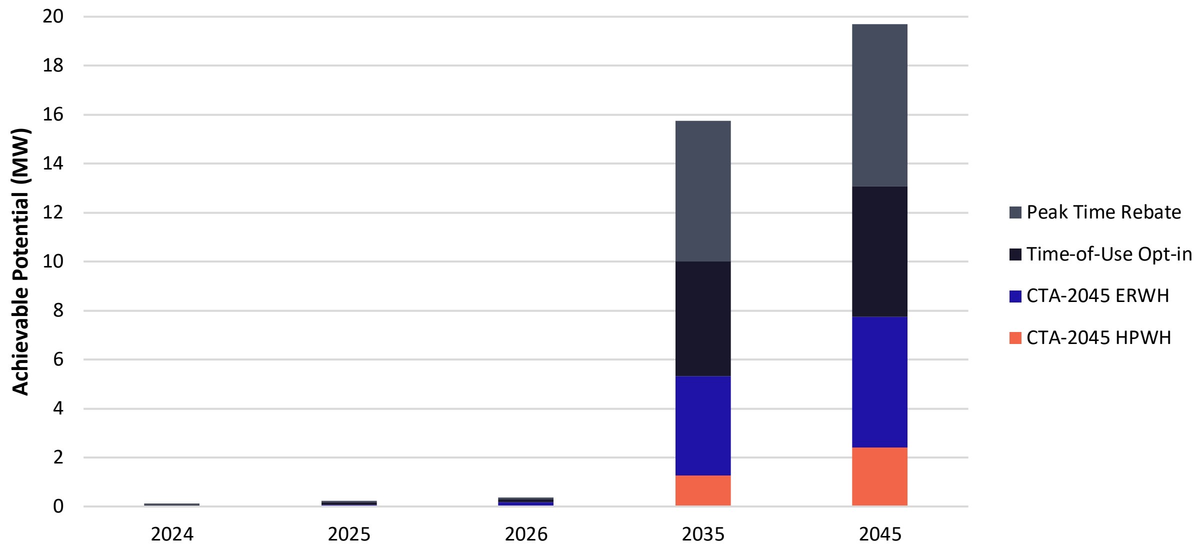


Table 6-19 Summary of Winter Potential by Option (Pilot MW @ Generator)

	2024	2025	2026	2035	2045
Baseline Forecast (MW)	**913**	**918**	**921**	**1,006**	**1,212**
Achievable Potential (MW)	**0.1**	**0.3**	**0.4**	**15.6**	**19.6**
CTA-2045 HPWH	0.0	0.0	0.0	1.4	2.6
CTA-2045 ERWH	0.0	0.1	0.2	4.3	5.7
Time-of-Use Opt-in	0.1	0.1	0.1	3.8	4.3
Peak Time Rebate	0.0	0.1	0.1	6.1	7.0

Table 6-20 Winter Potential by Class (Pilot MW @ Generator), Washington

	2024	2025	2026	2035	2045
Residential	0.1	0.2	0.4	13.8	17.1
General Service	0.0	0.0	0.0	1.9	2.5

A | MARKET PROFILES

This appendix presents the market profiles for each sector and segment for Washington and Idaho, in the embedded spreadsheet.

B | MARKET ADOPTION (RAMP) RATES

This appendix presents the Power Council's 2021 Power Plan ramp rates we applied to technical potential to estimate Achievable Technical Potential.

Table B-1 Measure Ramp Rates

Ramp Rate	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
LO12Med	11%	22%	33%	44%	55%	65%	72%	79%	84%	88%	91%	94%	96%	97%	99%	100%	100%	100%	100%	100%
LO5Med	4%	10%	16%	24%	32%	42%	53%	64%	75%	84%	91%	96%	99%	100%	100%	100%	100%	100%	100%	100%
LO1Slow	1%	1%	2%	3%	5%	9%	13%	19%	26%	34%	43%	53%	63%	72%	81%	87%	92%	96%	98%	100%
LO50Fast	45%	66%	80%	89%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
LO20Fast	22%	38%	48%	57%	64%	70%	76%	80%	84%	88%	90%	92%	94%	95%	96%	97%	98%	98%	99%	100%
LOEven20	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
LO3Slow	1%	1%	3%	6%	11%	18%	26%	36%	46%	57%	67%	76%	83%	88%	92%	95%	97%	98%	99%	100%
LO80Fast	76%	83%	88%	92%	95%	97%	98%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Retro12Med	11%	11%	11%	11%	11%	10%	8%	6%	5%	4%	3%	3%	2%	2%	1%	1%	0%	0%	0%	0%
Retro5Med	4%	5%	6%	8%	9%	10%	11%	11%	11%	9%	7%	5%	3%	1%	1%	0%	0%	0%	0%	0%
Retro1Slow	0%	1%	1%	1%	2%	3%	4%	6%	7%	8%	9%	10%	10%	9%	8%	7%	5%	4%	2%	2%
Retro50Fast	45%	21%	14%	9%	6%	3%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Retro20Fast	22%	16%	11%	8%	7%	6%	5%	5%	4%	3%	3%	2%	2%	1%	1%	1%	1%	1%	1%	0%
RetroEven20	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Retro3Slow	1%	1%	2%	3%	5%	7%	8%	10%	11%	11%	10%	9%	7%	6%	4%	3%	2%	1%	1%	1%

C | MEASURE DATA

Measure level assumptions and data are available in the “Avista 2022 DSM Potential Study Measure Assumptions” workbook provided to Avista alongside this file.

D | DEMAND RESPONSE POTENTIAL APPENDIX

Equipment End Use Saturation

The end use saturation data is required to further segment the market and identify eligible customers for direct control of different equipment options. The relevant space heating equipment for DR analysis are electric furnaces and air-source heat pumps. Table D-1 below show saturation estimates by state and customer class for Washington and Idaho respectively. We assume slight growth trends in Central AC, Space Heating, and Electric Vehicle saturations through 2045. For Advanced Metering Infrastructure (AMI), Avista began their rollout in Washington in 2019 is expected to be fully rolled out by the start of the study. In Idaho, the AMI rollout has begun in 2022 and is expected to be complete by 2024.

Table D-1 End Use Saturations by Customer Class and State[18]

State	Customer Class	End Use Saturation	2023	2024	2025	2035	2045	Source
WA	Res	Central AC	43%	44%	46%	49%	56%	EE Study/Baseline Survey
WA	Res	Elec Space Heat	21%	21%	21%	21%	21%	EE Study/Baseline Survey
WA	Res	CTA-2045 ER Water Heat	0.4%	1.3%	6.6%	16%	22%	EE Study/Baseline Survey
WA	Res	CTA-2045 HP Water Heat	0.3%	0.8%	3.4%	8%	14%	EE Study/Baseline Survey
WA	Res	Elec Vehicles	0.3%	0.4%	0.6%	1.5%	8.3%	EE Study/Baseline Survey
WA	Res	Appliances	100%	100%	100%	100%	100%	Standard
WA	Res	AMI	100%	100%	100%	100%	100%	AMI program
WA	GS	Central AC	21%	21%	21%	21%	21%	EE Study/Baseline Survey
WA	GS	Elec Water Heat	0.0%	0.0%	0.0%	0.0%	0.0%	EE Study/Baseline Survey
WA	GS	CTA-2045 ER Water Heat	0.4%	1.2%	6.1%	14%	18%	EE Study/Baseline Survey
WA	GS	CTA-2045 HP Water Heat	0.2%	0.6%	3.5%	9.2%	17%	EE Study/Baseline Survey
WA	GS	Elec Space Heat	11%	11%	11%	11%	11%	EE Study/Baseline Survey
WA	GS	Thermal	59%	59%	59%	59%	59%	EE Study – Roof Top Unit
WA	GS	AMI	100%	100%	100%	100%	100%	AMI program
WA	LGS	Thermal	11%	11%	11%	11%	11%	EE Study - Chiller
WA	LGS	AMI	100%	100%	100%	100%	100%	AMI program
WA	XL LGS	Thermal	11%	11%	11%	11%	11%	EE Study - Chiller
WA	XL LGS	AMI	100%	100%	100%	100%	100%	AMI program
ID	Res	Central AC	45%	46%	48%	51%	59%	EE Study/Baseline Survey
ID	Res	Elec Space Heat	22%	22%	22%	22%	22%	EE Study/Baseline Survey
ID	Res	Elec Water Heat	46%	46%	45%	45%	43%	EE Study/Baseline Survey
ID	Res	CTA-2045 ER Water Heat	0%	0%	0%	0%	0%	EE Study/Baseline Survey
ID	Res	CTA-2045 HP Water Heat	0%	0%	0%	0%	0%	EE Study/Baseline Survey
ID	Res	Elec Vehicles	0.5%	0.6%	1.0%	2.4%	13%	EE Study/Baseline Survey
ID	Res	Appliances	100%	100%	100%	100%	100%	Standard
ID	Res	AMI	33%	66%	100%	100%	100%	3-year AMI deployment
ID	GS	Central AC	18%	18%	18%	18%	18%	EE Study/Baseline Survey
ID	GS	Elec Water Heat	40%	40%	40%	40%	40%	EE Study/Baseline Survey
ID	GS	CTA-2045 ER Water Heat	0%	0%	0%	0%	0%	EE Study/Baseline Survey
ID	GS	CTA-2045 HP Water Heat	0%	0%	0%	0%	0%	EE Study/Baseline Survey

[18] R = Residential, GS = General Service, LGS = Large General Service, XL LGS = Extra Large General Service

ID	GS	Elec Space Heat	10%	10%	10%	10%	10%	EE Study/Baseline Survey
ID	GS	Thermal	61%	61%	61%	61%	61%	EE Study – Roof Top Unit
ID	GS	AMI	33%	66%	100%	100%	100%	3-year AMI deployment
ID	LGS	Thermal	7.9%	7.9%	7.9%	7.9%	7.9%	EE Study - Chiller
ID	LGS	AMI	33%	66%	100%	100%	100%	3-year AMI deployment
ID	XL LGS	Thermal	7.9%	7.9%	7.9%	7.9%	7.9%	EE Study - Chiller
ID	XL LGS	AMI	100%	100%	100%	100%	100%	3-year AMI deployment

Mechanism and Event Hours

Table D-2 lists the DSM options considered in the study, including the eligible sectors, the mechanism for deployment, and the expected annual event hours (summer and winter hours combined if both seasons are considered). Ancillary services were broken out this year as subsets of viable parent programs to capture a more accurate depiction of their potential savings.

Table D-2 DSM Program Event Hours

DSM Option	Eligible Sectors	Annual Seasonal Hours	Average Event Duration (hours)	Estimated Number of Events per Year
Ancillary Battery Storage	Summer DR Event	36	6	6
Ancillary Cooling	Summer DR Event	36	3	12
Ancillary DLC WH	Summer DR Event	50	3	17
Ancillary EV	Summer DR Event	528	6	88
Ancillary Third Party	Summer DR Event	30	4	8
Battery Energy Storage	Summer DR Event	36	6	6
Behavioral	Summer DR Event	40	6	7
CTA-2045 ERWH	Summer DR Event	75	3	25
CTA-2045 HPWH	Summer DR Event	75	3	25
DLC Central AC	Summer DR Event	50	3	17
DLC Electric Vehicle Charging	Summer DR Event	528	6	88
DLC Smart Appliances	Summer DR Event	528	6	88
DLC Smart Thermostats - Cooling	Summer DR Event	36	3	12
DLC Water Heating	Summer DR Event	50	3	17
Electric Vehicle TOU Opt-in	Summer DR Event	528	6	88
Peak Time Rebates	Summer DR Event	40	4	10
Thermal Energy Storage	Summer DR Event	36	6	6
Third Party Contracts	Summer DR Event	30	4	8
Time-of-Use Opt-in	Summer DR Event	528	6	88
Time-of-Use Opt-Out	Summer DR Event	528	6	88
Variable Peak Pricing Rates	Summer DR Event	80	4	20
Ancillary Battery Storage	Winter DR Event	36	6	6
Ancillary DLC WH	Winter DR Event	50	3	17
Ancillary EV	Winter DR Event	528	6	88
Ancillary Heating	Winter DR Event	36	3	12
Ancillary Third Party	Winter DR Event	30	4	8
Battery Energy Storage	Winter DR Event	36	6	6
Behavioral	Winter DR Event	40	6	7
CTA-2045 ERWH	Winter DR Event	75	3	25
CTA-2045 HPWH	Winter DR Event	75	3	25
DLC Electric Vehicle Charging	Winter DR Event	528	6	88
DLC Smart Appliances	Winter DR Event	528	6	88
DLC Smart Thermostats - Heating	Winter DR Event	36	3	12
DLC Water Heating	Winter DR Event	50	3	17
Electric Vehicle TOU Opt-in	Winter DR Event	528	6	88
Peak Time Rebates	Winter DR Event	40	4	10
Third Party Contracts	Winter DR Event	30	4	8
Time-of-Use Opt-in	Winter DR Event	528	6	88
Time-of-Use Opt-Out	Winter DR Event	528	6	88
Variable Peak Pricing	Winter DR Event	80	4	20

Integrated TOU Opt-out Achievable Technical Potential Results

In the TOU opt-out scenario, customers are placed on the Time-of-Use rate by default and will need to go through an added step to switch rates. Therefore, most potential among the rate design options are concentrated in TOU. Most of the participants are likely to be on the TOU pricing rate and we see a much lower savings potential for the Variable Peak Pricing Rates (1.1 MW by 2045 for summer and winter potential) and Peak Time Rebates (2.8 and 2.7 MW by 2045 for summer and winter potential respectively).

Summer Integrated TOU Opt-out Results

Figure D-1 and Table D-3 show the total summer demand savings from individual DR options. These savings represent integrated savings from all available DR options in the Washington and Idaho service territories.

- The highest savings potential is DLC Smart Thermostats, expected to reach savings of 30.7 MW by 2045.
- The next three biggest potential options in summer include, DLC Electric Vehicle Charging (29.3 MW), Third Party Contracts (29.1 MW), and Time-of-Use Opt-out (28.2 MW).
- The total potential savings in the summer TOU Opt-in scenario are expected to reach 161 MW by 2045, or 9% of system peak.

Figure D-1 Summary of Summer Potential by Option – TOU Opt-Out (MW @Generator)

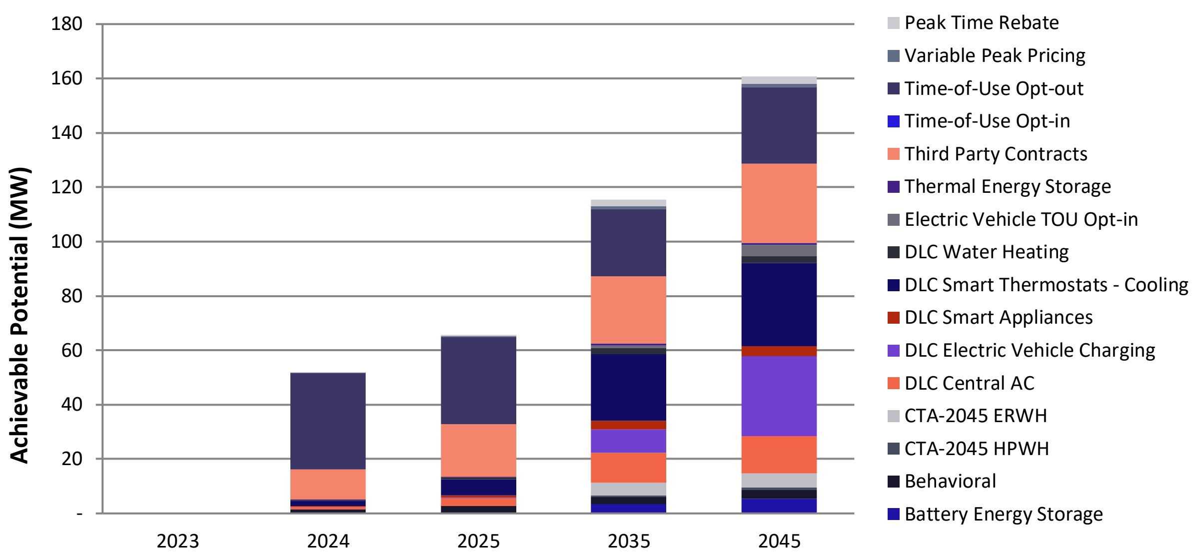


Table D-3 Summary of Summer Potential by Option – TOU Opt-Out (MW @Generator)

	2023	2024	2025	2035	2045
Achievable Potential (MW)	0	52	66	115	161
Battery Energy Storage	-	0.1	0.2	3.4	5.5
Behavioral	-	1.4	2.5	2.7	3.0
CTA-2045 HPWH	-	0.0	0.0	0.6	1.0
CTA-2045 ERWH	-	0.0	0.1	4.6	5.3
DLC Central AC	-	0.9	2.9	11.1	13.7
DLC Electric Vehicle Charging	-	0.0	0.2	8.4	29.3
DLC Smart Appliances	-	0.3	0.9	3.3	3.7
DLC Smart Thermostats - Cooling	-	1.9	5.9	24.5	30.7
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	-	0.2	0.6	2.2	2.4
Electric Vehicle TOU Opt-in	0.0	0.1	0.1	1.0	4.2
Thermal Energy Storage	-	0.1	0.2	0.7	0.7
Third Party Contracts	-	11.2	19.5	24.9	29.1
Time-of-Use Opt-in	-	-	-	-	-
Time-of-Use Opt-out	-	35.4	32.1	24.6	28.2
Variable Peak Pricing	-	0.0	0.2	1.0	1.1
Peak Time Rebate	-	0.1	0.5	2.5	2.8

Winter Integrated TOU Opt-out Results

Figure D-2 and Table D-4 show the total winter demand savings from individual DR options for selected years. These savings represent integrated savings from all available DR options in Avista's Washington and Idaho service territories.

- The highest savings potential is Third Party Contracts, expected to reach savings of 30.7 MW in 2045.
- The next two biggest potential options include DLC Electric Vehicle Charging (29.3 MW) and Time-of-Use Opt-out (27.4 MW).
- The total potential savings in the winter TOU Opt-out scenario are expected to reach 123 MW by 2045, or 7% of system peak.

Figure D-2 Summary of Winter Potential by Option – TOU Opt-Out (MW @ Generator)

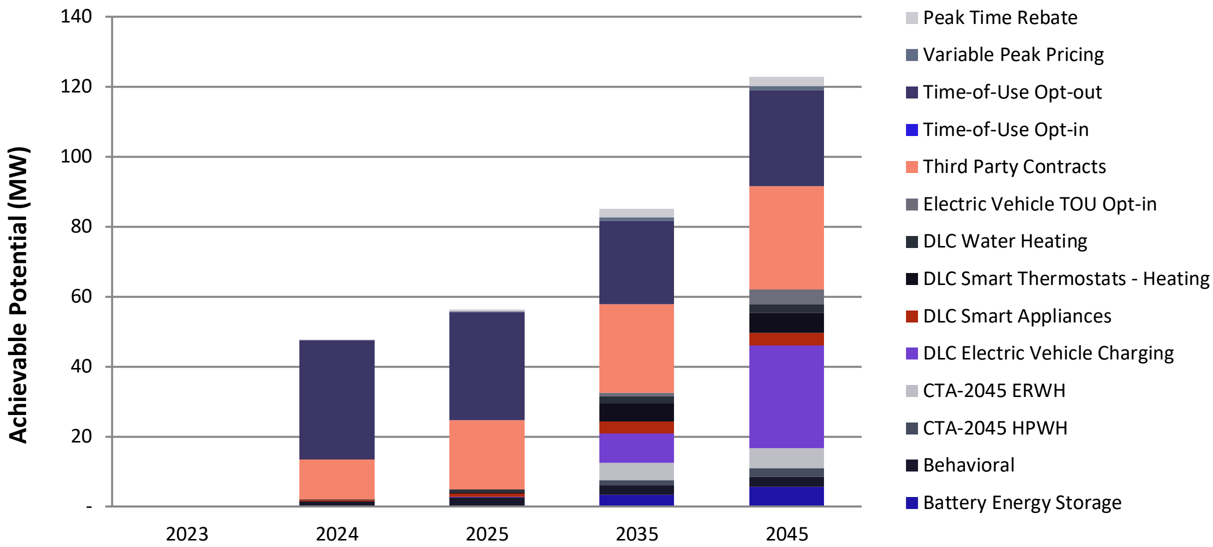


Table D-4 Summary of Winter Potential by Option – TOU Opt-Out (Winter MW @Generator)

	2023	2024	2025	2035	2045
Achievable Potential (MW)	0	48	56	85	123
Battery Energy Storage	-	0.1	0.2	3.4	5.5
Behavioral	-	1.3	2.3	2.5	2.9
CTA-2045 HPWH	-	0.0	0.0	1.6	2.6
CTA-2045 ERWH	-	0.0	0.1	5.0	5.7
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	0.0	0.2	8.4	29.3
DLC Smart Appliances	-	0.3	0.9	3.3	3.7
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	-	-	0.5	5.2	5.8
DLC Water Heating	-	0.2	0.6	2.2	2.4
Electric Vehicle TOU Opt-in	0.0	0.1	0.1	1.0	4.2
Thermal Energy Storage	-	-	-	-	-
Third Party Contracts	-	11.4	19.9	25.3	29.6
Time-of-Use Opt-in	-	-	-	-	-
Time-of-Use Opt-out	-	34.1	30.9	23.8	27.4
Variable Peak Pricing	-	0.0	0.2	1.0	1.1
Peak Time Rebate	-	0.1	0.5	2.3	2.7

Stand Alone Achievable Technical Potential Results

This section presents the stand-alone potential. For this scenario, we do not combine the potential savings and only show individual potential contributions by program for each scenario. Since the different rate options do not influence other rates in the stand-alone scenario, each rate has a larger potential savings than in the Opt-out/Opt-in scenarios.

Summer Stand-Alone Results

Figure D-3 and Table D-5 show the summer demand savings from individual DR options. These savings represent the individual stand-alone savings from all available DR options in Washington and Idaho service territories.

- The largest potential option is TOU Opt-out, contributing 39.6 MW in 2045.
- The next two biggest potential options include DLC Smart Thermostats – Cooling (30.7 MW), DLC Electric Vehicle Charging (29.3 MW), and Third Party Contracts (29.1 MW).
- When each TOU option is examined as an individual program, the Time-of-Use Opt-out option has a much larger potential savings then if participants could opt-in to the rate. The TOU Opt-out option makes up the second-largest savings potential in the stand-alone case and is expected to reach 31.1 MW by 2045.

Figure D-3 Summary of Summer Potential by Option – Stand Alone (MW @Generator)

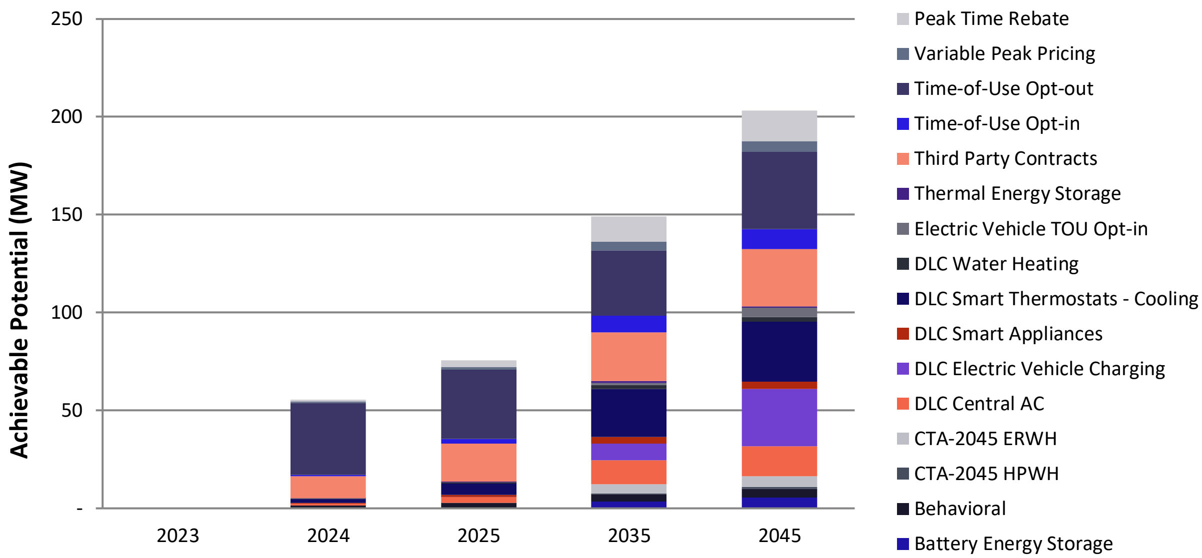


Table D-5 Summary of Summer Potential by Option – Stand Alone (MW @ Generator)

	2023	2024	2025	2035	2045
Achievable Potential (MW)	0	55	75	149	203
Battery Energy Storage	-	0.1	0.2	3.4	5.5
Behavioral	-	1.4	2.6	3.7	4.4
CTA-2045 HPWH	-	0.0	0.0	0.6	1.0
CTA-2045 ERWH	-	0.0	0.1	4.6	5.3
DLC Central AC	-	1.0	2.9	12.3	15.4
DLC Electric Vehicle Charging	-	0.0	0.2	8.4	29.3
DLC Smart Appliances	-	0.3	0.9	3.3	3.7
DLC Smart Thermostats - Cooling	-	1.9	5.9	24.5	30.7
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	-	0.2	0.6	2.2	2.4
Electric Vehicle TOU Opt-in	0.0	0.1	0.1	1.1	4.7
Thermal Energy Storage	-	0.1	0.2	0.8	0.8
Third Party Contracts	-	11.2	19.5	24.9	29.1
Time-of-Use Opt-in	-	0.7	2.3	8.6	10.3
Time-of-Use Opt-out	-	37.0	35.2	33.3	39.6
Variable Peak Pricing	-	0.4	1.4	4.7	5.4
Peak Time Rebate	-	1.0	3.4	12.8	15.5

Winter Stand Alone Results

Figure D-4 and Table D-6 show the winter demand savings from individual DR options. These savings represent stand-alone savings from all available DR options in Washington and Idaho service territories.

- The largest potential option is TOU Opt-out, contributing 38.3 MW by 2045.
- The next biggest options include Third Party Contracts and DLC Electric Vehicle Charging, contributing 29.6 MW and 29.3 MW by 2045, respectively.
- Since the different rate options do not influence other rates in the stand-alone scenario, each rate has a larger potential savings than in the Opt-out/Opt-in scenarios.

Figure D-4 Summary of Winter Potential by Option – Stand Alone (MW @Generator)

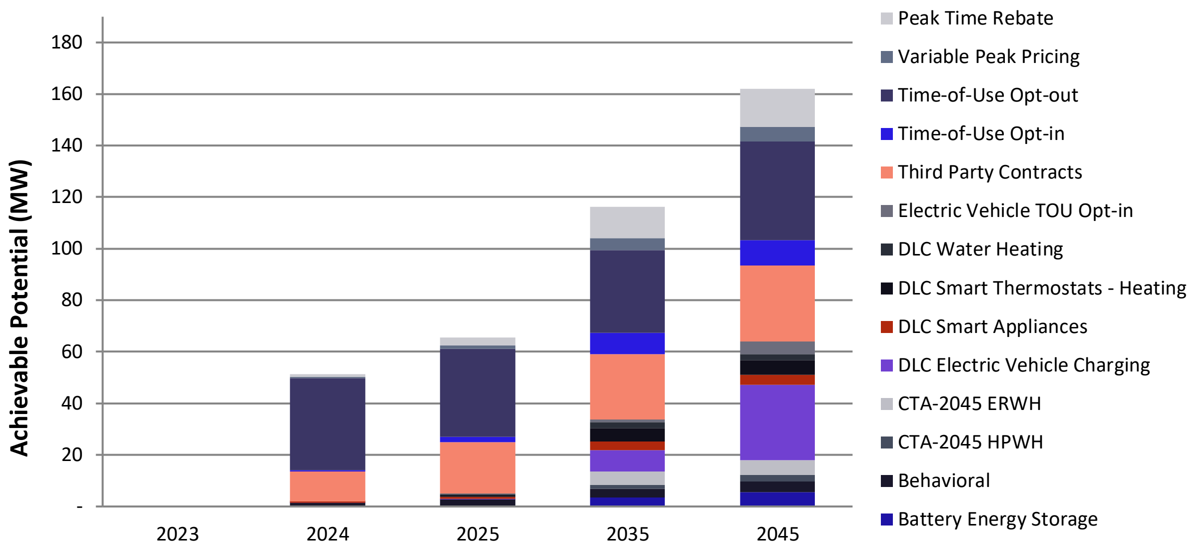


Table D-6 Summary of Summer Potential by Option – Stand Alone (MW @ Generator)

	2023	2024	2025	2035	2045
Achievable Potential (MW)	0	51	66	116	162
Battery Energy Storage	-	0.1	0.2	3.4	5.5
Behavioral	-	1.3	2.4	3.5	4.2
CTA-2045 HPWH	-	0.0	0.0	1.6	2.6
CTA-2045 ERWH	-	0.0	0.1	5.0	5.7
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	0.0	0.2	8.4	29.3
DLC Smart Appliances	-	0.3	0.9	3.3	3.7
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	-	-	0.5	5.2	5.8
DLC Water Heating	-	0.2	0.6	2.2	2.4
Electric Vehicle TOU Opt-in	0.0	0.1	0.1	1.1	4.7
Thermal Energy Storage	-	-	-	-	-
Third Party Contracts	-	11.4	19.9	25.3	29.6
Time-of-Use Opt-in	-	0.7	2.2	8.3	9.9
Time-of-Use Opt-out	-	35.7	34.0	32.1	38.3
Variable Peak Pricing	-	0.4	1.4	4.8	5.5
Peak Time Rebate	-	0.9	3.2	12.1	14.8

Pilot Stand Alone Results

Figure D-5 and Table D-7 show the summer demand savings from individual DR pilot options. These savings represent stand-alone savings from all available DR options in Avista's Washington and Idaho service territories. Total potential savings for summer pilot programs are expected to reach 22.2 MW by 2045.

Figure D-5 Summary of Summer Potential by Option – Stand Alone Pilot (MW @Generator)

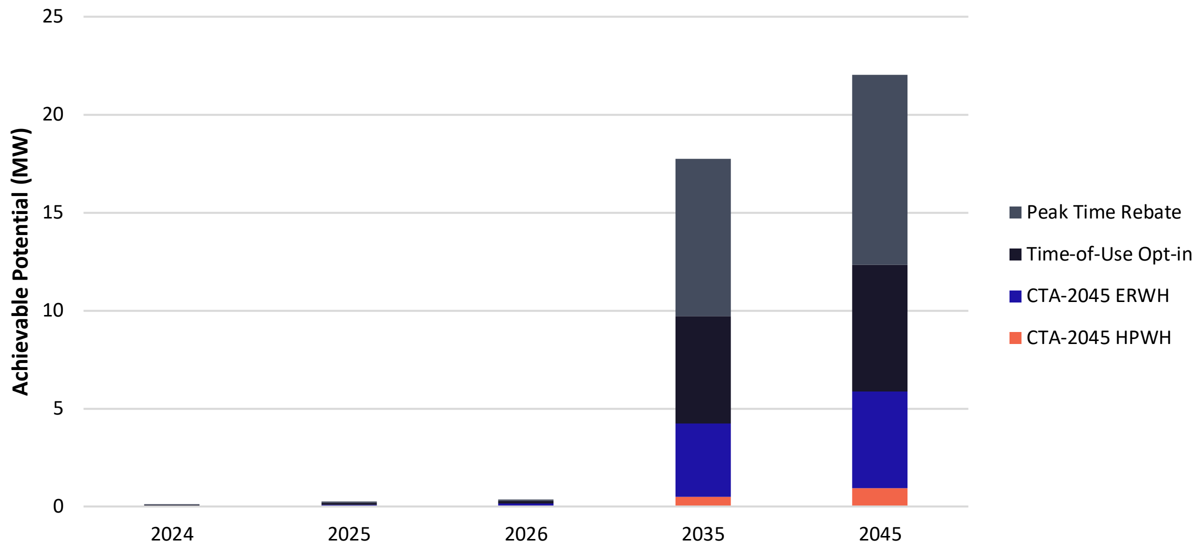


Table D-7 Summary of Summer Potential by Option – Stand Alone Pilot (MW @ Generator)

	2024	2025	2026	2035	2045
Achievable Potential (MW)	0.1	0.3	0.4	17.8	22.2
CTA-2045 HPWH	0.0	0.0	0.0	0.5	1.0
CTA-2045 ERWH	0.0	0.1	0.2	4.0	5.3
Time-of-Use Opt-in	0.1	0.1	0.1	4.7	5.6
Peak Time Rebate	0.0	0.1	0.1	8.6	10.3

Figure D-6 and Table D-8 show the winter demand savings from individual DR pilot options. These savings represent stand-alone savings from all available DR options in Washington and Idaho service territories. Total potential savings for winter pilot programs are expected to reach 23.3 MW by 2045.

Figure D-6 Summary of Winter Potential by Option – Stand Alone Pilot (MW @Generator)

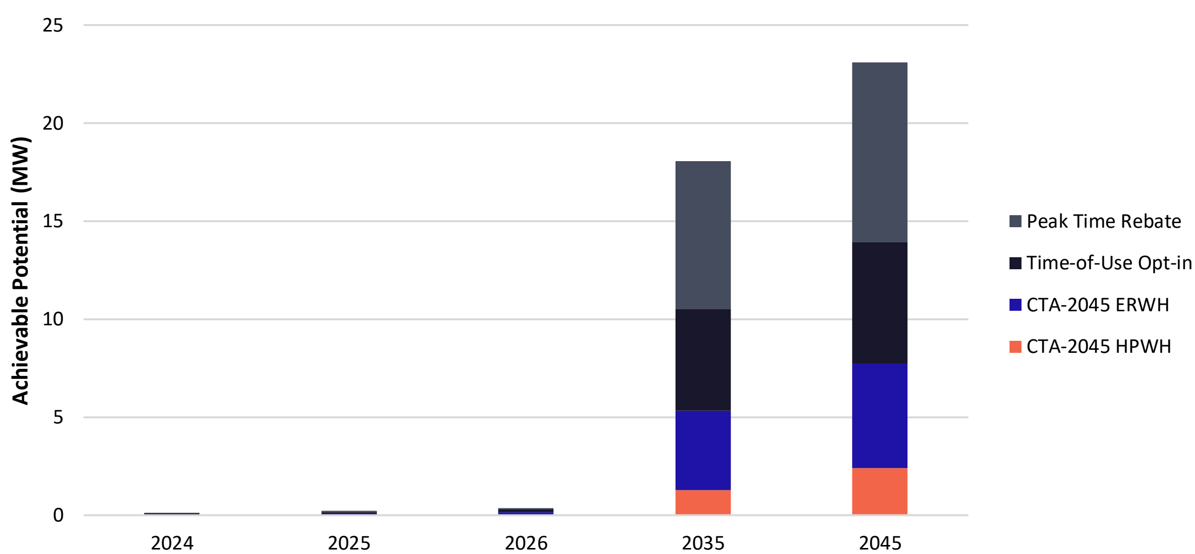


Table D-8 Summary of Winter Potential by Option – Stand Alone Pilot (MW @ Generator)

	2024	2025	2026	2035	2045
Achievable Potential (MW)	0.1	0.3	0.4	18.1	23.3
CTA-2045 HPWH	0.0	0.0	0.0	1.4	2.6
CTA-2045 ERWH	0.0	0.1	0.2	4.3	5.7
Time-of-Use Opt-in	0.1	0.1	0.1	4.4	5.2
Peak Time Rebate	0.0	0.1	0.1	8.0	9.8

Ancillary Services

Traditionally, ancillary services have been defined broadly as an option for Avista to use that stem from other DR programs at their disposal. This year, AEG wanted to provide Avista with feasible ancillary programs that are subsets of several programs defined above. AEG chose eight parent programs on which to base ancillary options: Battery Storage, DLC Water Heating (Idaho only), Grid-Interactive Water Heating (Washington only), Smart Thermostats Cooling and Heating, DLC Electric Vehicle Charging, and Third Party Contracts. The results in this section are considered to be separate from the achievable potential discussed earlier in this chapter.

The ancillary programs were replicas of their parent programs with several exceptions. For participation, AEG assumed the same participation as the parent program for Battery Energy Storage, Electric Vehicle Charging, DLC Water Heating, and CTA-2045 Water Heating, projecting that the same customers would also be eligible for an ancillary program. Participation in Third Party Contracts was based on the saturations of EMS systems for commercial customers in the PacifiCorp territory, and the participation in Smart Thermostat Programs was assumed to be half of their respective parent programs.

For Impact assumptions, AEG assumed the same impacts for ancillary Battery Energy Storage, DLC Water Heating, and CTA-2045 Water Heating programs as their parent programs. For Ancillary Third Party Contracts, AEG assumed a 75% realization rate of the parent impact since there is more of a change a C&I customer will contribute less on an ancillary option. For Smart Thermostat and EV DLC Charging options, AEG assumed half the impacts of their respective parent programs.

Since the ancillary programs are subsets of the main programs, AEG assumed the ancillary programs would take half of the administrative and development costs of the parent programs to implement. In addition, to avoid double counting, equipment costs and O&M costs were assumed to be zero for all ancillary programs. The ancillary programs assume the same annual marketing and recruitment costs and incentive costs as their parent programs.

Table D-9 and Table D-10 show the summer and winter demand savings from individual DR options for selected years of the analysis. These savings represent integrated savings from all available DR options in Avista's Washington and Idaho service territories.

The results show that an ancillary service option run through the EV DLC program would garner the most potential savings in both summer and winter seasons. This is due to the high potential impact per customer of this program at 75% of an average participant's EV load, as well as the inclusion of the latest EV forecast.

Table D-9 Summer Peak Ancillary Service Option, TOU Opt-in (@Generator)

Summer Potential	2023	2024	2025	2035	2045
Baseline Forecast (Summer MW)	1,404	1,408	1,415	1,548	1,864
Achievable Potential (MW)	-	2	5	26	45
Achievable Potential (%)	0%	0%	0%	2%	2%
Ancillary Battery Storage	-	0.1	0.2	3.4	5.5
Ancillary Cooling	-	0.5	1.5	6.1	7.7
Ancillary DLC WH	-	0.2	0.6	2.2	2.4
Ancillary HPWH	-	0.0	0.0	0.6	1.0
Ancillary ERWH	-	0.0	0.1	4.6	5.3
Ancillary EV	-	0.0	0.1	5.5	19.1
Ancillary Heating	-	-	-	-	-
Ancillary Third Party	-	1.4	2.5	3.2	3.7

Table D-10 Winter Peak Ancillary Service Option, TOU Opt-in (MW @Generator)

Winter Potential	2023	2024	2025	2035	2045
Baseline Forecast (Summer MW)	1,365	1,369	1,376	1,505	1,816
Achievable Potential (MW)	-	2	4	22	40
Achievable Potential (%)	0%	0%	0%	1%	2%
Ancillary Battery Storage	-	0.1	0.2	3.4	5.5
Ancillary Cooling	-	-	-	-	-
Ancillary DLC WH	-	0.2	0.6	2.2	2.4
Ancillary HPWH	-	0.0	0.0	1.6	2.6
Ancillary ERWH	-	0.0	0.1	5.0	5.7
Ancillary EV	-	0.0	0.1	5.5	19.1
Ancillary Heating	-	-	0.1	1.3	1.4
Ancillary Third Party	-	1.5	2.5	3.2	3.8

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