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Attachment 3

SBW's

"Independent Third-Party Review of PSE's 2010-2011 Electric Conservation Energy Savings"

June 1, 2012

PSE PUGET SOUND ENERGY
The Energy To Do Great Things

Report by **SBW CONSULTING, INC.**

Report No. **1201**

FINAL REPORT

INDEPENDENT THIRD-PARTY REVIEW OF PSE'S 2010-2011 ELECTRIC CONSERVATION ENERGY SAVINGS

Submitted to

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Additionally, Dave Nightingale at the Washington Utilities and Trade Commission, and members of the Conservation Resources Advisory Group provided valuable guidance throughout the process.

EXECUTIVE SUMMARY

Introduction

The Washington Utilities and Transportation Commission issued an order in 2010 adopting a settlement agreement between Puget Sound Energy and various stakeholder parties. This settlement superseded the electric portion of an existing 2002 settlement agreement. The settlement continued all the previous conditions, as well as adding others for approving PSE's ten-year electric conservation potential and biennial electric energy savings target, in compliance with the electric energy conservation portfolio standard required by the Washington Energy Independence Act (also known as I-937). One of the added conditions mandates a one-time independent third-party review of the electric energy savings reported by PSE for the 2010-2011 biennium. This report, which builds upon the December 2011 interim report, provides a final documenting of the methodology, findings, and conclusions from the third-party review.

Objectives

The primary purpose of this review is to assess the extent to which the electric energy savings that PSE reported for their electric conservation portfolio in the 2010-11 biennium were achieved. This report provides a final documenting of the third-party review of accomplishments over this biennium. This review is being completed at the direction of PSE and WUTC staff, with further input and oversight provided by the Conservation Resource Advisory Group (CRAG).

The three objectives of this study were as follows:

- Portfolio Savings Review. Determine the veracity of total portfolio electric energy savings[1] reported by PSE, relative to the targets and baselines established at the time of program approval by the Commission. This includes verifying that both RTF deemed and non-RTF-derived measure savings are being applied consistent with the Settlement.
- EM&V Practices Review. Assess whether EM&V practices are consistent with both the Settlement and generally accepted industry practices, particularly concerning tracking and reporting processes, installation verification practices, and evaluation planning, implementation, and follow-up.
- Cost-effectiveness Calculation Review. Audit of cost-effectiveness results, including review of methodology, inputs, and calculation, to determine if it is consistent with the Settlement.

[1] The energy savings discussed throughout this report are *gross* savings, and do not take into account adjustments commonly

Methodology

Each of the study objectives required tailored approaches, although many synergies existed between the different elements. The approaches for each element are summarized below: Figure E-1 provides an overview of the review process.

Portfolio Savings Review. The review team developed an initial understanding of the programs and data by reviewing key documentation and interviewing key managers and selected staff. The review team then performed a high-level portfolio review by reconciling the figures in the 2010 and 2011 Annual Reports with supporting data. In conjunction with this, the team performed a systematic and comprehensive examination of three separate samples of individual project files spanning the 2010-11 program years. This effort compared the file contents to the tracking data and centralized deemed savings in the Measure Metrics database (PSE's comprehensive database for tracking savings histories for all deemed measures). The team also reviewed the project files for discrepancies and cost and savings values with inadequate documentation.

After the 2010 interim report was issued, several more elements were added to the portfolio savings review, namely, targeted on-site verification of a subset of projects which received file review, and in-depth examinations of the procedures and savings estimates for the Resource Conservation Manager and Single-Family New Construction programs (Tariffs E253 and E215, respectively). The final step was to distill the separate findings from the various elements of the portfolio savings review to develop a final conclusion about the veracity of PSE's 2010-11 savings claim.

EM&V Practices Review. This review focused on three different elements: (1) tracking and reporting processes, (2) measure installation verification, and (3) evaluation planning and application. Each had its own methodology.

- *Tracking and reporting processes*

  The review team obtained relevant project tracking database extracts and reports, as well as internal studies of these systems. The team conducted an overall assessment of database fields, their use, and accuracy of the data. This went beyond the portfolio savings review, which focused on verifying the overall portfolio savings numbers using the tracking data, to a more broad-based assessment of the various ways the tracking information is used. The review team had numerous conversations, meetings, and e-mail exchanges with PSE staff to develop an understanding of their tracking databases. Our team reviewed the flat files and Access documentation to the extent that database documentation limitations permitted.

- *Measure installation verification*

  The review team used interviews with program staff, as well as reviews of relevant procedural documents and example project files, to develop a sense of how programs are verifying that measures were implemented properly and are yielding energy savings. We collected and reviewed the quality of the verification documentation, and assessed whether it was adequate. A more

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1.2 Overview

detailed review was subsequently conducted in early 2012 to examine verification procedures related to third-party program implementers and the commercial rebate program. These areas were prioritized because relevant program information had been lacking for the 2010 interim review.

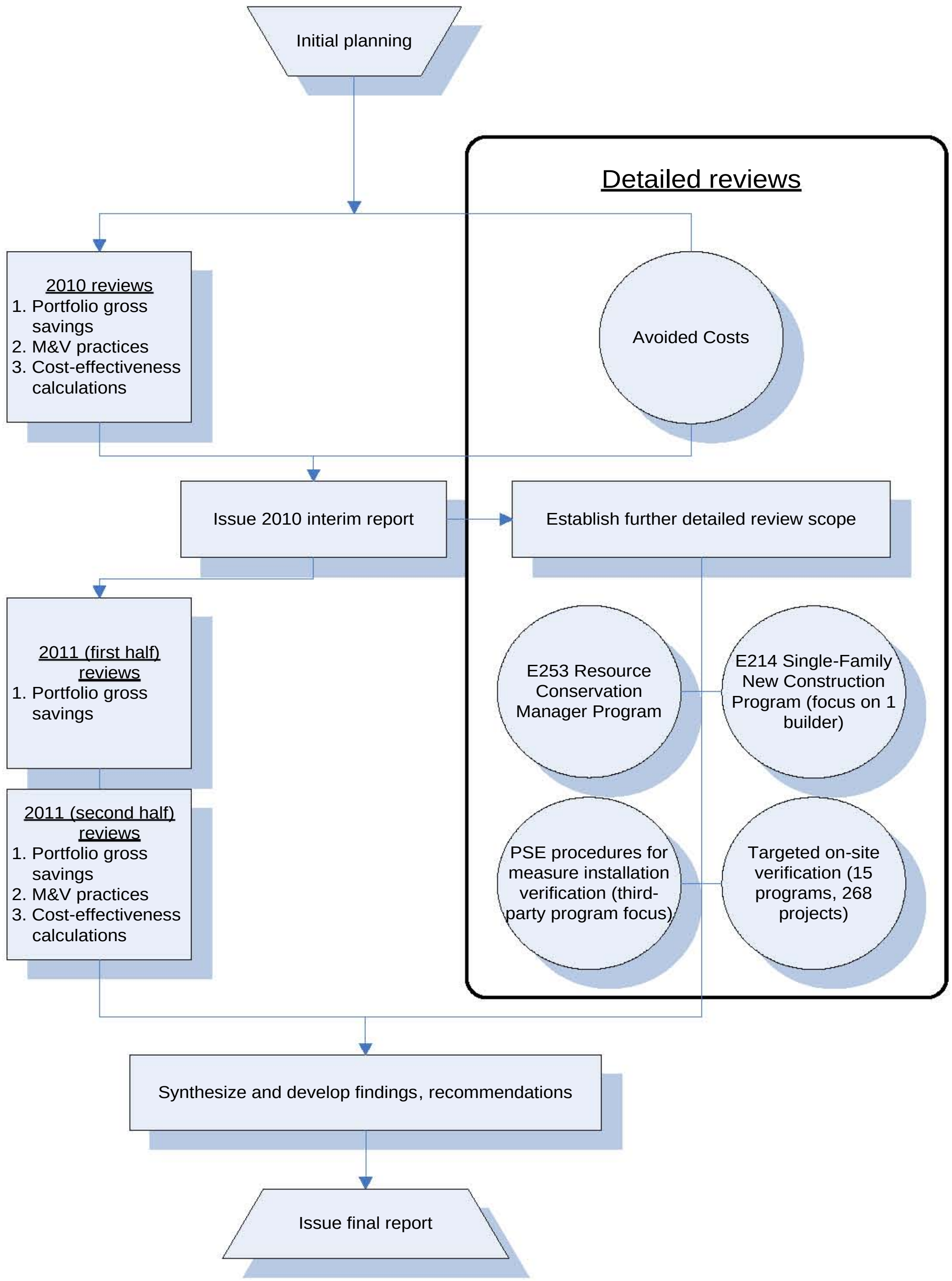


Figure E-1: Overview of Third-party Review.

- *Evaluation planning and application*

  The review team examined both past evaluation work that informs the current 2010-11 programs, as well as current evaluation plans and activities that will affect programs in the 2012-13 program cycle. First, the team obtained relevant M&V documentation from PSE, well as overarching planning and procedural documents. Since the evaluation approach is changing, the team split the documents into two groups, past and current, based on the date of publication. The team used a single approach to review the documents from both groups, and develop a portfolio-wide context matrix. After examining the summaries and matrix, the team developed questions for a meeting with key evaluation group staff to better understand PSE's historical M&V practices, how it sets evaluation priorities, how it uses evaluation results to improve programs, and other efforts that it has employed to establish evaluation policies and frameworks.

Cost-effectiveness Calculation Review. The team reviewed PSE's cost-effectiveness calculations reported in the 2010 and 2011 annual conservation reports to determine if the correct methodology was used, consistent with National Action Plan for Energy Efficiency, industry practices and the settlement agreement. This effort also involved a due diligence review, which included running PSE program data in the ProCost tool to calculate total resource costs (TRC) using Northwest Pacific Power and Conservation Council inputs. The review team also examined the results from the Washington State Conservation Work Group study, which compared utility methodologies for calculating TRC to those of the Council.

Avoided Cost Calculation Review. Early in the process, PSE and the UTC determined that the review should cover PSE's integrated resource plan (IRP) approach to calculating avoided costs. To accomplish this, the review team identified the elements for comparison between the IRP and Northwest Power Council Sixth Plan methodology and inputs to developing avoided energy and capacity costs. The team compared the approach of each planning process along several dimensions—such as modeling approach, input assumptions, transparency, and uncertainty—to identify similarities and highlight any significant differences that would likely lead to significantly different outcomes. The review team also examined the results from the Washington State Conservation Work Group study, which compared utility methodologies for determining avoided costs to those of the Council.

Findings

The review team's findings, after carrying out the methodologies described above for each of the six areas of investigation, are summarized below.

Portfolio Savings Review. Our comparison of reported savings to program tracking database savings for 2010 and 2011 found that program-specific values matched across the board, with three very minor exceptions. PSE provided advance notice of the two largest discrepancies, and the third was very small. Collectively, these discrepancies were negligible.

The review team also carried out a four-pronged assessment that consisted of (1) an examination of files and supporting information for 469 projects sampled across the portfolio for both the 2010 and 2011 program years, (2) on-site inspections of a subset of 268 of these projects that targeted residential and business programs of particular interest, (3) detailed reviews of 20 sampled RCM projects with follow-up onsite interviews of five customers, and (4) a detailed review of the records and practices associated with the largest participant in the Single-Family New Construction program.

Overall, the review team was generally satisfied with the documentation and explanations they were given regarding the claimed savings for the sampled projects. Considering the complexity and diversity of the PSE portfolio, this was fairly remarkable. Discrepancies that turned up in the file reviews and on-site visits tended to be infrequent and minor, and in our estimation, did not materially affect the overall savings claim. The review team assessed PSE's proposed increase in the 2011 savings claimed for the Home Energy Report (HER) program, based on independent evaluation results that became available in April 2012. We found the basis for the increase to be valid. Regarding the RCM program, we did have concerns about the documentation and savings calculation methodology for the RCM program, and feel that savings for that program appear to be overstated, although a full program evaluation would be required to accurately assess the impact. With this exception, though, it appears that PSE has done a credible job of tracking and reporting its program accomplishments for the 2010-11 electric efficiency portfolio.

EM&V Practices Review

- ***Tracking and reporting processes***

  PSE's tracking systems consist of five interlinked modules, including CSY, which tracks payment requests and savings primarily for business programs, and CMS, which performs similar functions for residential programs. PSE's long-term plan is for CMS to become the central system for all Energy Efficiency Services (EES) programs. PSE has also performed an internal study of tracking and reporting improvements, which identified numerous shortcomings and recommended improvements in database design, standardization, naming conventions, documentation, and training.

  After assessing PSE's internal review and comparing it with the data products and practices encountered during our efforts, the review team affirmed PSE's own findings at all levels. This included the necessity of defining key information needed to track and report program progress, carefully documenting tracking systems, integrating all program data, and ensuring data quality.

  Many of the challenges that the review team encountered obtaining tracking system data and documentation must be viewed in the context of the tremendous growth of the PSE EES portfolio in recent years. The addition of new programs and third-party-administered offerings has required that EES expand their tracking systems dramatically and rapidly to accommodate the increased complexity and transaction volumes in the 2010 portfolio. EES has provided evidence that its management has foreseen this need, and has begun upgrading their systems.

- ***PSE measure installation verification***

  An initial review of PSE's verification practices and comparison with best practices led the review team to conclude that PSE's efforts are satisfactory, as we did not find any significant issues in PSE's reporting of energy savings. A more in-depth review of the verification practices for the third-party-implemented and commercial rebate programs found that methods for those programs are generally consistent with best practices for verifying that actual product installations match energy efficiency program records and documentation.

  These favorable findings stem mostly from good verification practices, including: (1) using the Measure Metrics database to track important information for all measures, (2) employing comprehensive verification checklists for some rebated measures, (3) conducting pre- and post-inspection of all custom grant projects, (4) subjecting very large projects to multiple reviews, (5) inspecting at least one project per contractor for programs, and (6) considering costs in prioritizing verification needs.

  Nonetheless, the review team observed some current PSE practices that could potentially be enhanced. These areas of improvement are, for the most part, already being considered by PSE and/or their consultants. Regarding tracking systems, we noted missing elements and information, and some elements of projects being tracked in separate spreadsheets. As for verification procedures, we noted that not all programs have detailed verification procedures, and that the documentation was spotty. In particular, the review team did not receive process information or documentation on verification processes for third-party programs.

  PSE has developed an M&V framework that defines policies, guidelines, protocols, and M&V processes, mostly from a program implementation, rather than evaluation, perspective. This framework will help define the inspection and verification processes, according to best practices.

- ***Evaluation planning and application***

  The review team investigated PSE's past, current, and future evaluation efforts and plans, engaged in in-depth discussions with PSE evaluation staff, and compared PSE evaluation activities with industry best practices. The team found that past evaluations, which should be informing the 2010 programs, only covered a small portion of the overall electric portfolio. According to PSE, this is in part because much of the portfolio savings used RTF unit energy savings, reducing the potential influence of impact evaluations. Process and market evaluations in particular were rare. Common problems with the studies included lack of research plans, limited documentation, and narrowly-defined scope more suitable for answering specific research questions than assessing overall program performance.

  In the last couple of years, however, PSE has ramped up the breadth and rigor of their M&V efforts substantially. Evidence of this includes developing M&V action plans and frameworks, establishing an evaluation response report system to help complete the evaluation loop, and commissioning more comprehensive evaluations of major program areas (such as commercial/industrial retrofit, and single-family existing programs), and expanding the scope of the process and impact evaluations. Evaluation budgets have risen significantly as well, consistent with the increased activity.

Cost-effectiveness Calculation Review. The review team determined that for PSE to be in compliance with the Settlement Agreement would require meeting four criteria. First, the portfolio must pass the TRC test and be consistent with the Council's methodology. PSE's cost-effectiveness approach is consistent with the latter. Differences include: (1) Using average annual avoided costs versus four segments monthly, (2) not including non-energy benefits, (3) performing program-level, rather than measure-level, calculations, and (4) not including O&M costs. Second, PSE must provide results for the TRC, PAC (UC), PCT, and RIM tests. This has not yet occurred, because the latter two are only required starting in 2012 within the definitions provided by NAPEE. Third, PSE's programs must be cost-effective at the program and portfolio levels. Fourth, their definitions of "cost-effectiveness" and "system cost" must match Council's. PSE has met all of these requirements, and their methodology is consistent with Council guidance for TRC calculation.

Avoided Cost Calculation Review. Overall, PSE and the Council use a robust approach to develop their resource plans. Both approaches start with industry standard software to develop price forecasts and evaluate sensitivities. In addition, both use these forecasts as inputs to model portfolio uncertainty and to incorporate risk. The modeling approaches for both entities are conceptually similar. Both use the same electric market model software package to generate hourly electricity forecasts. Both entities provide extensive documentation on their assumptions and process, address uncertainty using scenario analysis, and incorporate risk when generating optimal resource mix. The differences are found in the assumptions that form the foundations for the forecasts. PSE and the Council use different sources for model inputs, but this is not unexpected given that each entity is modeling a slightly different region. Overall, we found consistencies between approaches, reasonable assumptions, credible sources, and sufficient documentation details.

Conclusions and Recommendations

Drawing from project file reviews, on-site verification, and detailed reviews of two programs of particular interest, the review team has thoroughly assessed the claimed savings in PSE's electric energy efficiency portfolio for the 2010-11 biennium, as required by the settlement agreement. This review was an expansive effort, consisting of a review of nearly 500 project files and thousands of program documents, on-site visits to nearly 300 projects, and dozens of interviews of PSE staff and selected customers. We note that throughout the yearlong process, PSE staff were unfailingly cooperative, prompt, and forthcoming in responding to the review team's numerous requests for information.

Generally, we have verified that PSE's 2010-11 savings claim is sound, defensible, and well-documented. This includes an increase to claimed 2011 Home Energy Report savings based on very recent evaluation results, which the review team validated. We periodically uncovered small documentation discrepancies, but these were minor and in our minds were not symptomatic of larger systemic problems that could call into question the veracity of the claimed savings for a program. Considering the breadth and depth of the scrutiny PSE received during the third-party review process, this is remarkable, and speaks well to the management and procedures.

The only exception is savings associated with the Resource Conservation Manager Program (Tariff E253), which accounts for 7% of the total electric savings for the biennium. While this program appears to us to be popular, well-run, and offering important services to the commercial sector, we were concerned that the savings may be overstated. We understand the extreme difficulties inherent in quantifying savings from such a program, and appreciate the uncertainties in doing so. Nonetheless, we feel that some reduction of the RCM savings claim is warranted. Based on our re-analysis of the data supporting the PSE RCM claim, a reduction within the range of 0% and 35% deserves consideration. Given the uncertainty in this range that stems from schedule and scope limitations, choosing a value for this adjustment is ultimately a qualitative judgment, and should not replace the results of a full impact evaluation, In any event, the overall effect of this adjustment to the portfolio savings is minor: a potential adjustment in the middle of the range would reduce portfolio savings by about 1.2%. Table E-1 provides a summary of the portfolio savings review, including this adjustment. It is important to note that regardless of the RCM adjustment made (within the stated range), the PSE 2010-11 portfolio will have exceeded its electric savings target of 622,000 MWh.

Table E- 1: Summary of Portfolio Savings Review

Tariff	Program	% of claimed 2010-11 savings verified [(a)]	Claimed savings (MWh)	Verified savings (MWh)
E200	Residential Information Services	100%	-	-
E201	Low Income Weatherization	100%	6,417	6,417
E202	Energy Education	100%	-	-
E214	Single Family existing	100%	-	-
	Home-print, Water Heat	100%	5,139	5,139
	Residential EE Lighting Rebate	100%	142,562	142,562
	Space Heat	100%	10,526	10,526
	Refrigeration Decommissioning	100%	8,303	8,303
	Primary Refrigerator Replacement	100%	469	469
	Energy Star Clothes Washers	100%	6,129	6,129
	Showerheads	100%	4,389	4,389
	Weatherization	100%	15,810	15,810
E215	Single Family New Construction	100%	4,174	4,174
E216	Single Family Fuel Conversion	100%	4,770	4,770
E217	Multi Family Existing	100%	28,942	28,942

Tariff	Program	% of claimed 2010-11 savings verified [a]	Claimed savings (MWh)	Verified savings (MWh)
E218	Multi Family New Construction	100%	3,634	3,634
E249	Pilots	100%	-	-
	Other than Reports	100%	480	480
	Home Energy Reports	100%	7,034 [b]	7,034
All Residential		**100%**	**248,778**	**248,778**
E250	Commercial/Industrial Retrofit	100%	162,214	162,214
E251	Commercial/Industrial New Construction	100%	35,230	35,230
E253	Resource Conservation Manager Services	83% [c]	45,360	37,422
E255	Small Business Lighting Rebate	100%	50,237	50,237
E257	LED Traffic Signals	100%	1,510	1,510
E258	Large Power User - Self Directed	100%	9,998	9,998
E260	Commercial Energy Efficiency Information	100%	-	-
E262	Commercial Rebate	100%	44,098	44,098
All Business		**98%**	**348,646**	**340,708**
E254	Northwest Energy Efficiency Alliance (NEEA)	100%	47,000	47,000
Various	Efficiency support and other related activities	100%	-	-
TOTAL		**99%**	**644,424**	**636,486** [d]

(a) Includes findings from targeted on-site verification (Section 2.3) and detailed reviews (Sections 2.4 and 2.5).

(b) This figure adjusted upwards from 5,093 MWh in 2011 Annual Report, based on independent evaluation results that became available in April 2012.

(c) Assumes an adjustment of 17.5%, which is midway between the PSE claimed savings and the adjustment calculated by the review team. This is based on an expectation that the actual savings lies somewhere in between these two points, but the true value has not yet been established.

(d) Note that this value exceeds PSE's two-year savings target of 622,000 MWh by 2.3%. Even if a more aggressive reduction of 35% on the RCM claim were applied, PSE would still exceed their target.

The review team found that PSE's approach to determining cost-effectiveness and avoided costs was sound, and in compliance with Council methodology. In examining tracking and reporting practices, measure installation verification, and evaluation planning, however, the team found a number of areas of potential improvement, at least compared with how these were carried out in 2010-11, and developed recommendations for addressing these areas. We also found strong evidence that PSE has made significant changes to bolster their practices in these areas. Table E- 2 summarizes the review team's findings for each major topic reviewed.

While many of the recommendations listed below have been apparent to PSE for some time, they are summarized below for the sake of completeness. The recommendations listed below are consolidated across the various review elements, since similar issues came up in different contexts. Details of the recommendations can be found in the corresponding sections.

Table E- 2: Summary of Review Findings

Report section	Topic	Overall findings
2.1	Portfolio savings	Claimed savings match the program tracking data, with a few inconsequential exceptions. Final adjusted HER program savings were judged valid, based on a review of evaluation results. NEEA savings were not included in the review.
2.2	Project file reviews	Sampled project files match up well with claimed savings, and provide reasonable supporting documentation.
2.3	On-site verification	On-site observations were consistent with PSE documentation. Infrequent discrepancies were not significant, and did not appear to be systemic.
2.4	E253 – Resource Conservation Manager program	Claimed savings are overstated because of an unsound savings calculation methodology. Program should improve documentation and revise savings estimation protocol. A full program evaluation is recommended as soon as possible to better understand realized energy savings.
2.5	E215 – SF New Construction program	Claimed savings are valid for large builder's projects in this program.
3.1	Tracking and reporting processes	Affirmed PSE's internal review recommendations for improvements in definitions, documentation, integration, and QC. Rapid program growth has posed challenges, but PSE management is attentive to these and is taking steps to rectify them.
3.2	Measure installation verification procedures	No evidence that verification procedure shortcomings led to improper savings claims. PSE has already taken major steps to standardize and buttress weaknesses in verification systems.
3.3	Evaluation planning and application	Past evaluations to inform 2010-11 programs were minimal, often lacked documentation, and were narrowly defined. PSE has ramped up M&V since then, and formalized planned activities.
4	Cost-effectiveness calculations	Calculations conform to Settlement Agreement and are consistent with Council guidance. Some load shapes were mis-assigned, but their impact was small, and would increase cost-effectiveness. PSE is addressing this issue. 2011 cost-effectiveness information submittal was improved over 2010.
5	Avoided cost	PSE's approach is consistent with the Council's, and used reasonable assumptions, credible sources, and sufficient documentation details.

Overview of recommendations

Portfolio savings

- Revise savings calculation methodology and documentation for RCM program.
- Investigate problems identified during on-site verification visits with residential duct sealing and particular commercial lighting measures.
- Investigate whether current showerheads unit energy savings apply to future initiatives similar to the 2011 Holiday Outreach program, and if not, determine more appropriate savings values.

Tracking and reporting processes

- Develop consistent and complete program tracking databases.
- Carefully document how to use tracking systems.
- Integrate all program data.
- Ensure data quality consistent with best practices.

Measure installation verification

- Improve documentation of verification and inspection processes.
- Enhance and standardize verification, particularly for third-party programs.

Evaluation planning and application

- Assess and monitor implementation of new evaluation efforts.
- Accelerate comprehensive evaluation of RCM program.

Cost-effectiveness calculations

- Develop a consistent approach for determining incremental measure cost across programs and measures, both for third-party and internal programs.
- Consider using weighted average avoided cost based on the mix of end uses within a program.
- Provide additional documentation for future avoided cost calculations.

1. Introduction

The Washington Utilities and Transportation Commission (WUTC) issued an order on September 28, 2010 adopting a settlement agreement (referred to in this report as the Settlement) between Puget Sound Energy (PSE) and various stakeholder parties. This settlement superseded the electric portion of an existing 2002 settlement agreement. The Settlement continued all the previous conditions, as well as adding others for approving PSE's ten-year electric conservation potential and biennial electric energy savings target, in compliance with the electric energy conservation portfolio standard required by the Washington Energy Independence Act[2]. The Settlement establishes the terms under which PSE has agreed to operate its electric energy efficiency programs. Among the added conditions in the Settlement is a requirement to conduct a one-time independent third-party review of the electric energy savings reported by PSE for the 2010-2011 biennium.

This report provides a final documenting of the third-party review, and builds upon the interim report that was issued on December 21, 2011. It documents the objectives of the third-party review, as well as the methodology, findings, and recommendations from each element of the review. This section describes the 2010-11 PSE electric energy efficiency portfolio, overall review approach, and main data sources. Section 2 presents methodology and findings for the portfolio savings review. Section 3 consists of three subsections, concerning tracking and reporting processes, measure installation verification, and evaluation planning and application. Section 4 addresses the cost-effectiveness calculations, while Section 5 deals with avoided costs. Section 6 presents the overall conclusions and recommendations from all portions of the review. The appendix that contains various supporting information and details.

1.1. PSE 2010-11 Portfolio

PSE offers its customers a broad range of programs and measures, across all of its customer classes, with claimed electric energy savings of 642,482 MWh of electric energy savings during the 2010-2011 biennium. Each of PSE's programs has its own tariff schedule approved by the WUTC. PSE reports its progress toward achieving its savings target on a semi-annual basis. The reports also describe PSE's program offerings, expenditures, and cost-effectiveness results. All energy savings are reported and evaluated on a gross basis (e.g., free riders are not netted out). PSE must derive electric energy savings from either the deemed savings estimates developed by the Regional Technical Forum (RTF)[3], or from other methods based on impact evaluation data or other relevant data that has verified savings levels.

[2] Approved by voters in 2006, the Energy Independence Act, also known as Initiative 937 (I-937) requires electric utility companies in the State of Washington to invest in renewable energy sources and energy conservation programs. I-937 requirements are codified in state law: Revised Code of Washington (RCW) 19.285 and Washington Administrative Code (WAC) 194-37.

[3] The Regional Technical Forum is an advisory committee established in 1999 to develop standards to verify and evaluate conservation savings for utilities in the Pacific Northwest.

The PSE 2010 Annual Report of Energy Conservation Accomplishments claims annual electric savings of 293,560 MWh/year, at a cost for the electric portion of $75,008,018. Table 3 provides additional details by program. The PSE 2011 Annual Report of Energy Conservation Accomplishments states that their portfolio yielded annual electric savings of 348,926 MWh/year, at a cost for the electric portion of $77,865,547. PSE revised this latter value upwards to 350,864 MWh/year to account for adjustments to claimed Home Energy Report savings.

Table 3: Claimed 2010-2011 Portfolio Electric Savings

		Savings (MWh/year)		
Tariff	**Program**	**2010**	**2011**	**Total**
E200	Residential Information Services	-	-	-
E201	Low Income Weatherization	2,701	3,716	6,417
E202	Energy Education	-	-	-
E214	Single Family existing			
	Home-print, Water Heat	1,298	3,841	5,139
	Residential EE Lighting Rebate	56,500	86,062	142,562
	Space Heat	5,568	4,958	10,526
	Refrigeration Decommissioning	5,724	2,579	8,303
	Primary Refrigerator Replacement	-	469	469
	ENERGY STAR Clothes Washers	3,370	2,759	6,129
	Showerheads	587	3,802	4,389
	Weatherization	10,117	5,693	15,810
E215	Single Family New Construction	2,633	1,541	4,174
E216	Single Family Fuel Conversion	3,163	1,607	4,770
E217	Multi Family Existing	11,090	17,852	28,942
E218	Multi Family New Construction	2,552	1,082	3,634
E249	Pilots			
	Other than Reports	188	292	480
	Home Energy Reports	-	7,034*	7,034
All Residential		**105,491**	**143,287**	**248,778**
E250	Commercial/Industrial Retrofit	82,618	79,596	162,214
E251	Commercial/Industrial New Construction	16,792	18,438	35,230
E253	Resource Conservation Manager Services	20,169	25,191	45,360
E255	Small Business Lighting Rebate	25,178	25,059	50,237
E257	LED Traffic Signals	334	1,176	1,510
E258	Large Power User - Self Directed	604	9,394	9,998
E260	Commercial Energy Efficiency Information	-		
E262	Commercial Rebate	18,874	25,224	44,098

		Savings (MWh/year)		
Tariff	Program	2010	2011	Total
All Business		**164,569**	**184,077**	**348,646**
E254	Northwest Energy Efficiency Alliance (NEEA)	23,500	23,500	47,000
Various	Efficiency support and other related activities	-	-	
TOTAL		**293,560**	**350,864**	**644,424**

* This figure adjusted upwards from 5,093 MWh in 2011 Annual Report, based on independent evaluation results that became available in April 2012.

1.2. Overview of Review

The primary purpose of this review is to assess the extent to which the electric energy savings that PSE reported for their electric conservation portfolio in the 2010-11 biennium were achieved. This report provides a final documenting of the third-party review of accomplishments over this biennium, and builds upon the interim report that was issued on December 21, 2011. This review is being completed at the direction of PSE and WUTC staff, with further input and oversight provided by the Conservation Resource Advisory Group (CRAG)[4].

Key objectives of the review are enumerated in Table 4 below.

Table 4: Objectives of Review

Task	Description	Relevant Settlement clause*	Task Objective
1	Portfolio Savings Review	K.(6)(b - c)	Determine the veracity of total portfolio electric energy savings (gross) reported by PSE, relative to the targets and baselines established at the time of program approval by the Commission. This includes verifying that both RTF deemed and non-RTF-derived Measure savings are being applied consistent with the Settlement.
2	EM&V Practices Review	K.(6)(f)	Assess whether EM&V practices are consistent with both the Settlement and generally accepted industry practices, particularly concerning tracking and reporting processes, installation verification practices, and evaluation planning, implementation, and follow-up.

[4] The CRAG consists of PSE, ratepayer representatives, regulators, and energy efficiency policy organizations, including the following stakeholder groups: WUTC staff, Attorney General's Office of Public Counsel, Northwest Power and Conservation Council, Northwest Energy Coalition, Energy Project, Industrial Customers of Northwest Utilities, Northwest Industrial Gas Users, Washington State Department of Commerce, Northwest Energy Efficiency Council, and customer representatives.

Task	Description	Relevant Settlement clause*	Task Objective
3	Cost-effectiveness Calculation Review	K.(10)(a - c)	Audit of cost-effectiveness results, including review of methodology, inputs, and calculation, consistent with the Settlement.
4	Detailed Program/Measure Reviews	n/a	Review in more detail the following programs or measures: Commercial/Industrial lighting retrofits Energy Smart Grocer Resource Conservation Manager Single-family weatherization Multifamily retrofit program Home Energy Report pilot At the discretion of PSE, UTC, and the review team, other areas may also warrant more detailed review.

* Relevant portions of the Settlement can be found in Appendix A.

The review design encompassed multiple approaches. The overall review process is depicted graphically in Figure 2. The review team carefully examined a wide range of selected documents, databases, and calculations underpinning the PSE 2010-11 portfolio claims. These are described in the next section. We also interviewed and submitted questions to key PSE managers and program personnel regarding these aforementioned records of programmatic activity to understand how they were developed. In addition, we selected random samples of project-level documentation for each program, and subjected these samples to careful scrutiny and analysis. In conjunction with this, we catalogued issues and problems we identified, and based on these, developed and carried out targeted detailed reviews of particular areas deserving of closer examination. These detailed reviews covered avoided costs, the Resource Conservation Manager and Single-Family New Construction programs, PSE measure verification practices, and targeted on-site verification of selected projects. By synthesizing information from these varied efforts, the review team developed overall findings and recommendations, which are documented in this final report. A draft version of this report was issued in April 2012 for comment by PSE, WUTC, and the CRAG. Their collective comments, combined with the review team's responses, can be found in Appendix B.

By examining the portfolio claims at both summary and detail levels, this review has ferreted out problems and potential improvements that can strengthen PSE's future claims, and assessed PSE's compliance with the settlement agreement reached with the WUTC.

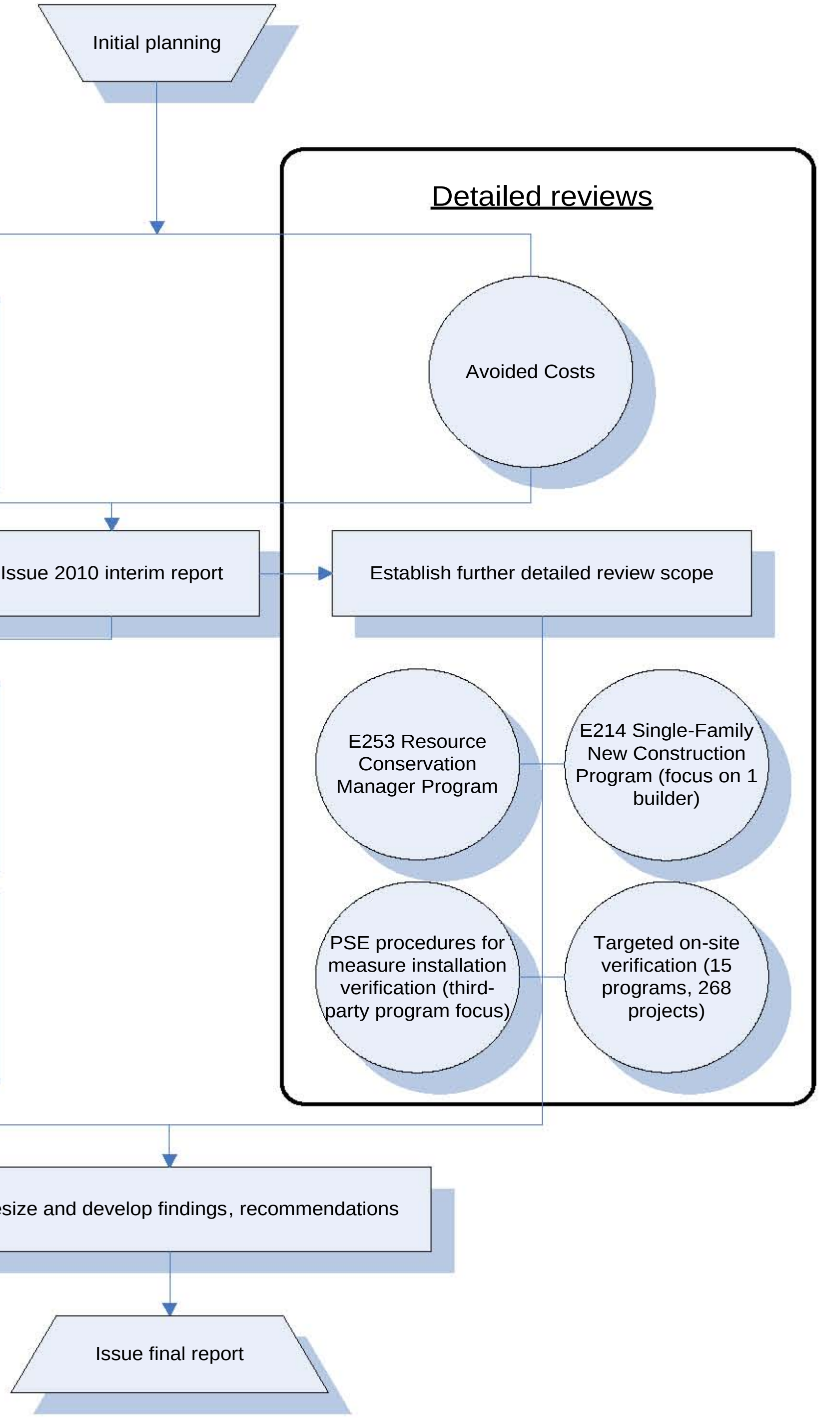


Figure 2: Overview of Third-party Review.

1.3. Data Sources

The list below describes the various categories of data the team relied upon to perform their review:

- **2010 and 2011 Annual Reports**: The two PSE annual reports served as the primary documentation of the claimed savings from 2010-11 conservation activities. The 2010 report is titled *2010 Annual Report of Energy Conservation Accomplishments*, and was filed in Docket No. UE-970686 on February 15, 2011. The 2011 report is titled *2011 Annual Report of Energy Conservation Accomplishments*. Both present overall and program-level expenditures and savings and cost-effectiveness ratios, as well as information about evaluation, measurement, and verification activities, programmatic activities in the residential and business sectors, regional programs and relationships, support activities, and stakeholder relationships for their respective program years. The reports also include appendices containing supporting data and documentation.
- **Interviews**: During the course of the review, the review team was in frequent contact over many months with numerous PSE Energy Efficiency Services (EES) managers to obtain information and clarification about programs, data, and evaluation activities. These contacts occurred in person, over the phone, and via e-mail, in both formal and informal contexts. Early meetings dealt with the review team's data requests and program organization. Later meetings focused on specific questions and issues raised by the review team's detailed review of the documentation and data.
- **Tracking database extracts**: PSE provided the review team with the spreadsheets that underlay the results shown in the 2010 and 2011 Annual Report tables. These contained summations, and in some cases, inventories of project results for each program, as well as details of the cost-effectiveness calculations.
- **Program database extracts**: When the information in the tracking database extracts was not detailed enough, PSE provided the team with program databases listing details of individual projects. The latter information was necessary to develop project review sample frames.
- **Sampled project files**: The review team sampled 329 PY2010 projects, comprising 608 measures, and 172 PY2011 projects, comprising 383 measures, to be assessed, for a total of 501 projects and 991 measures. For each of these, PSE provided information available in the project file relating to costs, savings, and installation verification. The volume of information varied considerably, from simple single-family residential retrofits, where the documentation often consisted of no more than one or two pages, to complex custom industrial projects, with hundreds of pages of supporting information.
- **Verification and inspection procedures and examples**: PSE provided an overview of procedures for measure qualification, verification, and random inspection. They also provided a number of examples of inspection reports. For the detailed review of inspection procedures, PSE also supplied information about inspection and measure passing rates, field forms, and more details about their procedures, criteria, and goals.

- **Measure Metrics**: Measure Metrics is PSE's database that tracks every current and retired deemed measure in each program, and the corresponding energy savings, incentive, and measure cost information. This serves as a reference for energy analysts when assigning deemed energy savings and incentives for a measure. PSE provided the review team with versions of this database that were in use in 2010 and 2011 for use in checking project claimed savings values.
- **EM&V plans and reports**: PSE provided copies of impact/process evaluations and market studies completed from 2007 through 2011. Also supplied for the interim report were plans for ongoing evaluations, as well as planning documents that describe evaluation policies, guidelines, and approaches that were adopted in the fall of 2011.
- **Cost-effectiveness and avoided cost calculators**: In addition to the tracking database extracts described above, PSE provided other calculations supporting cost-effectiveness estimates, measure lives, and avoided costs for the 2010-11 period. The latter included a draft version of PSE's 2011 integrated resource plan.

2. Portfolio Savings Review

The objective of this review was to determine the veracity of total portfolio electric energy savings reported by PSE relative to the targets and baselines established at the time of program approval by the Commission. This section describes the methodology the review team used to accomplish this, as well as the findings from both the high-level portfolio and project-level reviews.

The comprehensive due-diligence review of the savings claim involved first developing an initial understanding of the programs and data by reviewing key documentation and interviewing key managers and selected staff. The review team next performed a high-level portfolio review by reconciling the figures in the 2010 Annual Report with supporting data, as described in Section 2.1. Simultaneously, the team began a systematic and comprehensive examination of individual project files to compare against tracking data and centralized deemed savings in the Measure Metrics database and identify discrepancies and cost, savings, and measure life values with inadequate documentation, as described in Section 1.1. The review team repeated this process twice, once after the 2011 Semi-Annual Report was issued, and again after the 2011 Annual Report came out. After the 2010 interim report was issued in the fall of 2011, several more elements were added to the portfolio savings review, namely, targeted on-site verification of a subset of projects which received file review (Section 2.3), and in-depth examinations of the procedures and savings estimates for the Resource Conservation Manager (Section 2.4) and Single-Family New Construction (Section 2.5) programs.

The distillation of our separate findings from the four elements of the portfolio savings review addressed in this section—namely, the high-level portfolio review, the project-level reviews, the targeted on-site verification, and the detailed program reviews—can be found in the Conclusions portion (Section 6) of the report. This provides our ultimate conclusion about the veracity of PSE's 2010-11 savings claim.

2.1. High-level portfolio review

2.1.1. Methodology

Initial understanding of programs and data

The review team first carefully read the conservation report and other program materials to develop a preliminary understanding of the various energy efficiency offerings in the portfolio. We then held face-to-face meetings with various managers and staff members of the Evaluation, Residential Energy Management, Business Energy Management, and Budget and Administration departments of the PSE Energy Efficiency Services Division. These meetings provided the review team with a more complete understanding of the data and documentation available to them.

Reconciliation of 2010 and 2011 Reports and Supporting Data

The review team examined the 2010 and 2011 annual reports, and excerpted the claimed savings for each program and activity. We also obtained the master spreadsheets containing the numbers shown in the report tables for both reports. For each year, the team also received notification and supporting documentation for minor adjustments to savings to corrected small errors.

Before selecting the file review samples, it was necessary to make sure that all of the energy savings claimed records were present in the program tracking data provided by PSE. This was done by summing the energy savings for each program and element and comparing it to the claimed savings listed in Appendix A of each report. Each program has a different set of requirements and implementation method, so they have unique tracking systems and collect different information, e.g. third-party program operators track individual records and provide PSE with monthly summary data, while direct-install programs only track the installation address and number of devices installed.

The program tracking files for each program were standardized and combined into a single database to sum the energy savings and incentives by program and element. For programs that only reported counts of devices, the savings per project were calculated by multiplying the measure count by the unit savings. This database later became the pool from which the file review sample was drawn, a process that took place three times—for 2010, first half 2011, and second half 2011 projects..

Table 5 and Table 6 below provide a detailed breakdown of the residential and business energy management programs, respectively, during the 2010-11 biennium. Table 5 lists brief descriptions of program services, which Table 6 shows total expenditures and electric savings for each year, as documented in the PSE 2010 and 2011 Annual Reports. Overall, the portfolio claims annual savings of 642,486 MWh/year, obtained with expenditures of about $153 million. There are 16 programs for which PSE has claimed savings, ranging from very small programs, such as the Pilot programs (E249) with claimed savings of 480 MWh/year, to the Commercial/Industrial Retrofit program, with claimed savings of 162,214 MWh/year.

Table 5: 2010-2011 Residential & Business Energy Management Programs

Tariff	Program	Description of program services
Residential		
E200	Residential Information Services	Tailored information to both business and residential customers through Energy Advisors, energy efficiency brochures, on-line services and self-audits, and various events.
E201	Low Income Weatherization	Weatherization and energy-related repairs for low-income, single- and multi-family residences, including mobile homes.
E202	Energy Education	Powerful Choices provided information to community leaders and educators to pass on to a greater audience. The program was revised in mid-2010 to shift focus on training trainers.
E214	Single Family existing	Prescriptive rebates for customers, contractors, developers, trade allies, retailers, and manufacturers specific to single-family housing.
	HomePrint, Water Heat	HomePrint specialists evaluate homes and install efficiency measures. Efficient water heaters, including tankless models and heat pumps.
	Residential EE Lighting Rebate	Compact fluorescent (CFL) lamps and fixtures
	Space Heat	Air-source, geothermal, and ductless heat pumps.
	Refrigeration Decommissioning	Disposal of surplus, high-energy-usage refrigerators and freezers.
	ENERGY STAR Clothes Washers	Efficient washers.
	Showerheads	Low-flow showerheads.
	Weatherization	Home insulation and HVAC duct sealing.
E215	Single Family New Construction	Rebates and incentives for efficient lighting, appliances, HVAC, water heating in new single-family residences, including manufactured homes.
E216	Single Family Fuel Conversion	Incentives to replace electric space or water heating equipment with high-efficiency gas counterparts.
E217	Multi Family Existing	Rebates and incentives for efficient lighting, appliances, HVAC, water heating, and improved building envelope components.
E218	Multi Family New Construction	Rebates and incentives for efficient lighting, appliances, HVAC, water heating and improved building envelope components in new multi-family residences.
E249	Pilots	
	Other than Reports	Heat pump air handler/furnace fan motor upgrade; heat pump sizing and lockout controls; natural gas fireplaces.

Tariff	Program	Description of program services
	Home Energy Reports	Customized reports to help residential customers understand their energy usage and find ways to save.
Business		
E250	Commercial/ Industrial Retrofit	Incentives for upgrades to equipment (lighting, HVAC, refrigeration, etc.), building shell, industrial process, and select O&M improvements. Includes the Energy Smart Grocer and Building Energy Optimization (existing retrocommissioning) programs.
E251	Commercial/ Industrial New Construction	Incentives for efficiency upgrades that exceed codes/standard practice for new facilities or major remodels of all sizes.
E253	Resource Conservation Manager Services	Grants for large customers w/multiple facilities to hire a dedicated resource manager to reduce energy use by 10% or more over a three-year term.
E255	Small Business Lighting Rebate	Rebates for a wide range of lighting conversions in small businesses. Also provides a contractor and vendor network.
E257	LED Traffic Signals	Information and rebates for public sector customers w/traffic control authority.
E258	Large Power User - Self Directed	Large C/I users submit proposals for efficiency upgrades using the funds allocated by their tariff. This program operates on four-year cycles.
E260	Commercial Energy Efficiency Information	[see Residential Tariff E200]
E262	Commercial Rebate	Standardized rebates for common, relatively uniform measures in areas such as appliances, cooking equipment, controls, drives and motors, hospitality, HVAC, lighting, refrigeration and water heating. Includes Premium HVAC Service and PC Power Management.
All Business		
E254	Northwest Energy Efficiency Alliance (NEEA)	Support of regional upstream market transformation efforts through NEEA, a non-profit organization of regional energy utilities and groups.
Various	Efficiency support and other related activities	Numerous support activities, such as program evaluation, market research, supply curves, and pilot programs.

Table 6: 2010-2011 Program Expenditures and Claimed Savings

		2010			2011			Combined		
Tariff	Program	$ Spent (1,000 dollars)	Savings (MWh/year)	% of 2010 portfolio savings	$ Spent (1,000 dollars)	Savings (MWh/year)	% of 2011 portfolio savings	$ Spent (1,000 dollars)	Savings (MWh/year)	% of total portfolio savings
Residential										
E200	Residential Information Services	$882	-	-	$1,086	-	-	$1,968	-	-
E201	Low Income Weatherization	$2,726	2,701	1%	$2,288	3,716	1%	$5,014	6,417	1%
E202	Energy Education	$441	-	-	$115	-	-	$555	-	-
E214	Single Family existing									
	HomePrint, Water Heat	$1,586	1,298	0.40%	$1,244	3,841	1%	$2,830	5,139	1%
	Residential EE Lighting Rebate	$5,356	56,500	19%	$8,967	86,062	25%	$14,323	142,562	22%
	Space Heat	$1,665	5,568	2%	$1,851	4,958	1%	$3,516	10,526	2%
	Refrigeration Decommissioning	$892	5,724	2%	$713	2,579	1%	$1,605	8,303	1%
	Primary Refrigerator Replacement	-	-	-	-	469	0.13%	-	469	0.07%
	ENERGY STAR Clothes Washers	$2,552	3,370	1%	$2,702	2,759	1%	$5,254	6,129	1%
	Showerheads	$4	587	0.20%	$240	3,802	1%	$244	4,389	1%
	Weatherization	$2,520	10,117	3%	$2,037	5,693	2%	$4,557	15,810	2%
E215	Single Family New Construction	$1,256	2,633	1%	$853	1,541	0.44%	$2,108	4,174	1%
E216	Single Family Fuel Conversion	$794	3,163	1%	$430	1,607	0.46%	$1,224	4,770	1%
E217	Multi Family Existing	$4,275	11,090	4%	$5,005	17,852	5%	$9,280	28,942	4%
E218	Multi Family New Construction	$1,207	2,552	1%	$518	1,082	0.31%	$1,725	3,634	1%
E249	Pilots									
	Other than Reports	$69	188	0.10%	$73	292	0.08%	$142	480	0.07%
	Home Energy Reports	$450	-	-	$613	7,034	2%	$1,063	7,034	1%
All Residential		**$26,674**	**105,491**	**36%**	**$28,734**	**143,287**	**41%**	**$55,408**	**248,778**	**39%**
Business										
E250	Commercial/Industrial Retrofit	$22,367	82,618	28%	$18,498	79,596	23%	$40,865	162,214	25%
E251	Commercial/Industrial New Construction	$4,722	16,792	6%	$7,849	18,438	5%	$12,571	35,230	5%
E253	Resource Conservation Manager Services	$921	20,169	7%	$1,035	25,191	7%	$1,957	45,360	7%
E255	Small Business Lighting Rebate	$7,249	25,178	9%	$7,465	25,059	7%	$14,714	50,237	8%

		2010			2011			Combined		
Tariff	Program	$ Spent (1,000 dollars)	Savings (MWh/year)	% of 2010 portfolio savings	$ Spent (1,000 dollars)	Savings (MWh/year)	% of 2011 portfolio savings	$ Spent (1,000 dollars)	Savings (MWh/year)	% of total portfolio savings
E257	LED Traffic Signals	$14	334	0.10%	$34	1,176	0.34%	$48	1,510	0%
E258	Large Power User - Self Directed	$1,065	604	0.20%	$1,745	9,394	3%	$2,810	9,998	2%
E260	Commercial Energy Efficiency Information	$102	-	-	$49	-	-	$151	-	-
E262	Commercial Rebate	$2,570	18,874	6%	$2,481	25,224	7%	$5,052	44,098	7%
All Business		**$39,010**	**164,569**	**56%**	**$39,156**	**184,077**	**53%**	**$78,166**	**348,646**	**54%**
E254	Northwest Energy Efficiency Alliance (NEEA)	$4,946	23,500	8%	$5,242	23,500	7%	$10,188	47,000	7%
Various	Efficiency support and other related activities	$4,377	-	-	$3,315	-	-	$7,692	-	-
TOTAL		**$75,008**	**293,560**	**100%**	**$76,447**	**350,864**	**100%**	**$151,455**	**644,424**	**100%**

* This figure adjusted upwards from 5,093 MWh in 2011 Annual Report, based on independent evaluation results that became available in April 2012.

2.1.2. Findings

Our comparison of reported savings to program tracking database savings is provided in

below. For the 2010 program year, in all but one case, the claimed savings matched the program tracking data. The only non-matching records are for Program E214 (Single Family Existing Residential EE Lighting Rebate). In the case of this program, double counting of some rebate coupons was discovered after the February submission that led to a discrepancy of 190,320 kWh. Rather than removing these records from the program tracking database, PSE value simply subtracted this value from the original claimed value of 56,690 MWh, resulting in a final savings of 56,500 MWh, as shown in. PSE's revised submittal from April 2011 reflects this latter value.

For the 2011 program year there was a small discrepancy in the E214 Residential EE Lighting program, but it only amounted to a difference of 102 kWh, which is only a 0.00001% difference in the program savings. After the 2011 PSE savings report had been submitted and the program tracking files transferred to the review team, PSE discovered an erroneous claim of 3,314 kWh in the high-efficiency HVAC portion of Program E262. As this constituted a very small percentage difference in the total saving, PSE decided not to revise the 2011 report, but will include an adjustment for this in the 2012 biennial report.

The program savings for E214 Showerheads came from two sources; PSE tracking data for the mail in rebate, direct install, and retail measures rebated directly through PSE and the C+C showerhead giveaway counts distributed per city from their holiday outreach events. Although the PSE tracking data included itemized records for the showerhead rebates, C+C simply provided showerhead counts per city. Based on the evidence obtained, the review team concluded that the latter are a valid savings claim, though the fact that these showerheads were distributed late in the biennium precluded opportunity for more detailed review. Questions remain about the proper value for the unit energy savings, since the distribution method for the holiday outreach program differed from any of the methods (mail-by-request, retail, and direct install) considered by the RTF, and so it is possible that the savings estimate used for the holiday outreach may not accurately capture the results for this particular distribution. If PSE continues the holiday giveaway in future years, then the review team recommends further research into this issue.

It was not possible to confirm the claimed savings for the NEEA program, as the analysis was performed by NEEA and they simply report PSE's portion of the savings to them. NEEA looks for ways to increase the adoption of efficient equipment and reduce the barriers like availability and lack of information in the market while concurrently performing an evaluation to determine the effects of their market transformation program in a region. First the total regional energy savings is calculated by subtracting the baseline adoption (original number of units sold) from the actual number of units purchased and multiplying it by the unit energy savings of the equipment. The total energy savings is then divided into three categories; naturally occurring savings that would have happened without the existence of the program, utility program sponsored savings due to rebate programs, and the net market effect that is the remainder of the total energy savings attributed to the market transformation program. The net market effect value is reported to each utilities based on their relative contribution to the program. Since PSE's annual report must be submitted before NEEA's figures are finalized, PSE takes credit for only 75% of NEEA's preliminary savings estimate.

Table 7: Comparison of PSE Report and Database Savings

		2010		2011	
Code	Program Name	Report Savings	Database Savings	Report Savings	Database Savings
E200	Residential Information Services	0	0	0	0
E201	Low Income Weatherization	2,701	2,701	3,716	3,716
E202	Energy Education	0	0	0	0
E214	Single Family existing				
	Energy Star Clothes Washers	3,370	3,370	2,759	2,759
	Home-print/Water Heat	1,298	1,298	3,841	3,841
	Refrigeration Decommissioning	5,724	5,724	2,579	2,579
	Primary Refrigerator Replacement	0	0	469	469
	Residential EE Lighting Rebate*	56,500	56,690	86,062 [a]	86,062
	Showerheads	587	587	3,802	3,802 [b]
	Space Heat	5,568	5,568	4,958	4,958
	Weatherization	10,117	10,117	5,693	5,693
E215	Single Family New Construction	2,633	2,633	1,541	1,541
E216	Single Family Fuel Conversion	3,162	3,162	1,607	1,607
E217	Multi Family Existing	11,090	11,090	17,852	17,852
E218	Multi Family New Construction	2,552	2,552	1,082	1,082
E249	Pilots				
	Home Energy Reports	0	0	5,093	N/A
	Non-Home Energy Reports	188	188	292	292
All Residential		**105,490**	**105,680**	**141,345**	**136,252**
E250	C/I Retrofit	82,618	82,618	79,596	79,596
E251	C/I New Construction	16,792	16,792	18,438	18,438
E253	Resource Conservation Manager - RCM	20,169	20,169	25,191	25,191
E255	Small Business Lighting Rebate	25,178	25,178	25,059	25,059

		2010		2011	
Code	Program Name	Report Savings	Database Savings	Report Savings	Database Savings
E257	LED Traffic Signals	334	334	1,176	1,176
E258	Large Power User - Self Directed	604	604	9,394	9,394
E262	Commercial Rebate	18,874	18,874	25,224	25,227
All Business		**164,569**	**164,569**	**184,077**	**184,080**
TOTAL		**270,059**	**270,249**	**325,422**	**320,333**

(a) Corrected value shown here.

(b) Includes showerhead data from C+C Holiday Outreach events.

2.2. Project-level review

2.2.1. Methodology

The flowchart in Figure 3 illustrates key steps in the project-level review process. These steps are described in more detail in this section.

Develop sample frame

The review team developed three sample frames, one based on the projects for which savings were claimed in the 2010 Annual Report, a second based on projects associated with the 2011 Semi-Annual Report, and a third based on projects claimed in the second half of 2011 (representing additional projects completed in 2011 after the 2011 Semi-Annual Report was issued).

For each sample frame, we divided each program that had a savings claim associated with it (e.g. Energy Smart Grocer or multifamily new construction) according to the expected method the program used to estimate savings, as follows:

Deemed

- Low Income Weatherization
- MF Retrofit and New Construction
- Pilots, except Home Energy Reports
- SF Existing and New Construction
- SF Fuel Conversion
- C/I Lighting and Commercial Rebate
- LED Traffic Signals

Calculated

- MF and CI New Construction
- C/I Lighting and Commercial Rebate

Custom

- C/I and MF New Construction and Retrofit
- Commercial Rebates (non-lighting)
- Energy Smart Grocer
- High Voltage
- Resource Conservation Manager
- Home Energy Reports

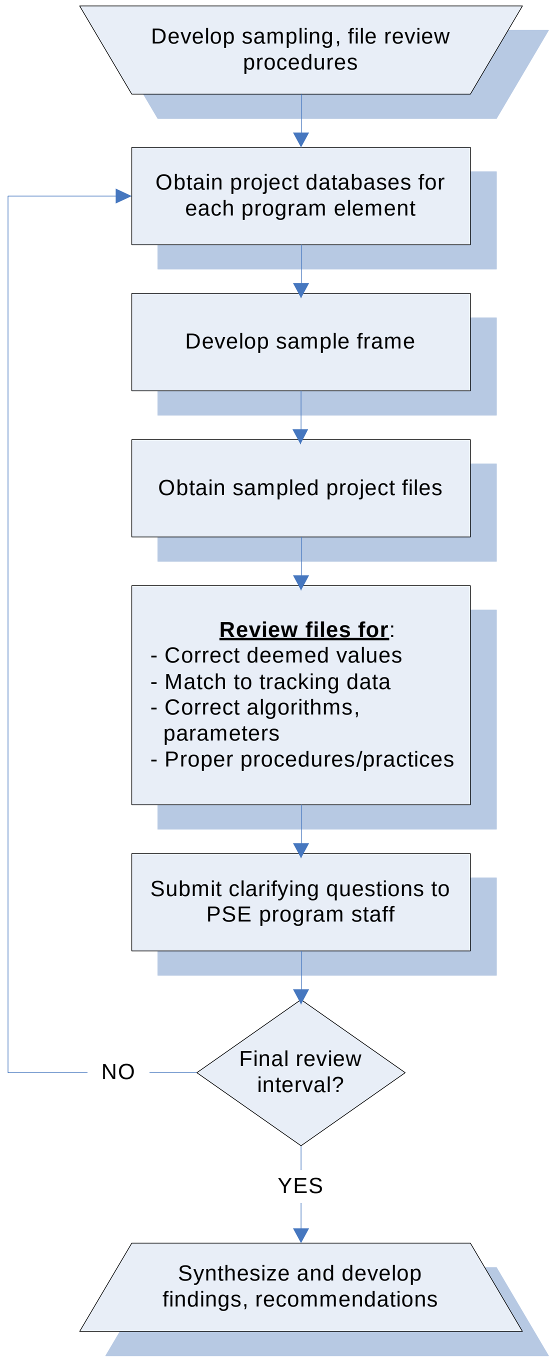


Figure 3: Overview of Project-Level Review.

We then assembled the various project lists and databases into a comprehensive sample frame, and developed a sampling plan. The objective of this plan was: to best allocate time budgeted for individual project reviews across the various programs and calculation methods. The steps required to develop this plan were as follows:

1. Divide programs into domains, based on calculation type and whether detailed review is desired,
2. Determine savings and population for each domain,
3. Develop a sample point allocation roughly proportional to savings, with a stratified approach for custom measures to account for their higher savings variance, and
4. Adjust the allocation to account for other factors, such as the desire to review at least two projects within each domain and to pay attention to the diversity of measures with the C/I retrofit domain. This allocation provided the basis for randomly selecting a set number of projects, as well as establishing time targets to guide the review effort for projects in each domain.

Prior to implementing the initial sample, the review team submitted the plan to PSE, WUTC, and the CRAG to confirm it was acceptable. Once each sample was finalized, we submitted lists of the sampled projects to PSE so that they could provide the corresponding project files for review. This process required considerable coordination to ensure that appropriate materials were available.

Review of individual projects

A standardized review process was developed and implemented for the sampled project files. This process included reviewing deemed values, comparing file values for the number of units and savings to those in the program tracking database, checking for correct algorithms and key parameters in simplified calculations, and making sure proper procedures and/or good practices were applied for custom projects. Where applicable, we also tracked down the inputs to the cost-effectiveness calculations, such as effective useful life or measure cost, for each sampled project. The review matrix framework is shown in Table 8 below. After compiling aggregate results for each domain, as well as issues specific to particular projects, the review team generated lists of questions for PSE program staff. After the initial review round dealing with 2010 projects, three face-to-face meetings were held so PSE could answer questions and provide additional background information and context to the reviewers. PSE also provided supplemental and missing materials in response to reviewer comments and requests. This up-front orientation and explanation obviated the need for such exchanges in the subsequent two review rounds.

Table 8: Project Review Matrix

Data class	Category	Subcategory	Parameter	Third-party review questions
PSE Tracking Data		Identifiers	Program Number	
			Project ID	
			Description of Project ID	
			Program	
			Subprogram	
			Sampling domain	
			Type of savings calculation	
		Measure	Measure description	
			Quantity	

Data class	Category	Subcategory	Parameter	Third-party review questions
		Savings	kWh savings	
			Hours of operation	
		Costs	Measure cost	
			Incentive payment amount	
			Incentive payment date	
Measure Metrics data			Measure type	
			Unit savings	
			Measure cost	
			Measure life	
3rd party review	General		Date requested	
			Date received	
			Reviewer	
				Was complete project file readily available from PSE? If not, why not?
				Is info complete, well-organized, and understandable?
	File comparison w/tracking data	Identifiers	Program number	Match? (Y/N)
			Project (CSY) number	Match? (Y/N)
			Facility type	No more than a few words to provide a general sense of types of facilities
		Measure	Measure description	Described accurately enough to match appropriate Measure Metrics value (if deemed)?
			Measure type	Match? (Y/N)
			Quantity	Match? (Y/N)
				Source of quantity info--invoices, other documents, inspections?
		Savings	Type of savings calculation	Note ONLY if different than expected
			kWh savings	Match? (Y/N)
			KWh ≠ reason	Note reason why savings values do not match
			Unit savings	If deemed, is UES correct for given measure (i.e., does it match M:M *[Measure Metrics database]*)?
			Hours of operation	Recorded value(s)
				Are values reasonable?
			Measure life	Consistent across measure types, Measure Metrics?
		Costs	Measure cost	Match? (Y/N)
				If No, input documentation cost
				Is it incremental, if appropriate?
			Incentive payment amount	Match? (Y/N)
				Payment amount <= measure cost? Reasonable amount?
			Incentive payment date	Date
				Was incentive paid / project claimed in appropriate year? (Y/N)
				Contains appropriate, detailed invoicing?
	Verification/ inspection			Evidence of pre and/or post inspection?
				Is location of business and measure(s) clearly described, so someone else could find them?
	Savings detail		Deemed	Right value chosen?
				Deemed value up to date?

Data class	Category	Subcategory	Parameter	Third-party review questions
				Does UES from M:M * Qty. = Tracking savings?
			Standard	Appropriate calculator?
				Reasonable input(s)?
			Custom	Briefly describe data collection, calculation methods.
				Reasonable input(s)?
				Rely on measured data for baseline (where applicable)?
				Rely on measured data for as-built?

Establishing focus and scope of detailed reviews

The 2010 portfolio review that the review team performed was designed to be comprehensive, within the schedule and budget constraints of the project at that time. For certain areas we were unable to complete our investigations because of these limitations, and thus we recommended further, more detailed study as part of the overall scope of the review. When the review began, six programs had been initially identified as possible candidates for detailed study, namely: Commercial/Industrial Lighting Retrofit, Multifamily Retrofit, Energy Smart Grocer, Home Energy Report (HER) pilot, Single-Family Weatherization, and Resource Conservation Manager (RCM). The review team discovered that all of these programs, with the exception of RCM, had either just been or were about to be evaluated, so a detailed review most likely would have been somewhat redundant with the work of the impact evaluations. The recent evaluation of the HER pilot developed a straightforward framework for continuing to assess savings, so additional detailed study would have been of limited value. The RCM program was the sole remaining program from the initial group for which the review team felt that detailed study was warranted.

In late 2011, the review team, PSE, WUTC, and CRAG members discussed the team's initial recommendations for further study. These parties ultimately agreed that the detailed studies should focus on four areas, namely, (1) the RCM program, (2) the Single-Family New Construction program, particularly projects associated with one large builder, (3) PSE's measure installation verification procedures, with focus on third-party-administered programs and the Commercial Rebate program, and (4) targeted on-site verification by the review team of selected projects that had already undergone file review. The methodology for each of these four areas is discussed in more detail later in this section.

2.2.2. Findings

Table 9 shows the total number of projects the review team established for each PSE program. The 2010 residential and business energy management portfolios accounted for 48,294 and 3,599 projects, respectively, for a total of 51,893 projects claimed in 2010. In some cases, projects were clearly defined by PSE database identification numbers, while in others, the team needed to use customer identification information to establish unique identifiers for defined projects. We then applied the sampling methodology described previously in Section 2.2.1 to develop a review sample of 185 residential and 99 business sector projects, for a total of 284 projects. Since many of these projects, particularly commercial lighting projects, comprised multiple measures, the sample consisted of 561 measures, or nearly two per project. The 2011 business and residential portfolios included 4,338 and 60,069 projects, respectively, for a total of 64,407 projects claimed in 2011. The same sampling methodology was applied to the two sectors and resulted in 99 sampled residential projects and 80 sampled business sector projects, for a total sample of 179 projects including 342 separate measures.

The project-level review did not address savings associated with E254 Northwest Energy Efficiency Alliance. Since these accrue from an upstream market transformation effort with savings determined in aggregate, there were no project files to be reviewed. In a similar vein, the review team did not sample the Home Energy Report (HER) component of the E249 Pilot Programs, since there were no individual project files to review. Instead, we reviewed two independent evaluations[5] of the HER program, as well as a WUTC-commissioned study by Lawrence Berkeley National Labs (LBNL) that concluded that the KEMA analytical approach was sound. The original HER savings claim in the 2011 Annual Report was based on the initial evaluation, and PSE revised this value after the Annual Report was issued based on new evaluated results presented in the second evaluation report. On the basis of these documents, the review team concluded that the final PSE savings claim was valid. The second KEMA evaluation report and the LBNL study are included in Appendix D.

Ultimately, though, the review team was generally satisfied with the documentation and explanations they were given regarding the claimed savings for the sampled projects. PSE has done a credible job of tracking and reporting program accomplishments for the 2010-11 electric efficiency portfolio. Although the review team spent hundreds of hours poring over thousands of pages of project documentation for hundreds of projects, we did not find any issues of significance (the one exception the is the RCM program, which is discussed separately in Section 2.4). The small issues we found are to be expected in a portfolio of this complexity, and in our opinion, do not call into question the overall veracity of the savings claim.

Individual records only provide a partial picture because other elements are contained in other places, e.g., costs often not found because third-party program measures are compiled in aggregate, or compiled elsewhere. Many of the issues the review team encountered while performing this task are discussed in more detail systemically in Section 3.1.

The process of obtaining project materials necessary to perform an adequate review of costs and savings was not always straightforward. We sometimes encountered difficulties, not because of unwillingness on PSE’s part, but because of the nature of the established systems and processes. One reason for this was the decentralized nature of the PSE EES databases. A second reason was the limited documentation of program procedures and processes that was available to us, which made it challenging to understand the context for the materials we reviewed, though this was mitigated by follow-up explanations by PSE staff. A third reason was the unusual structure of our review, which was

[5] Details of the reviews of these studies that were performed can be found in Table 42 in Appendix E, under Study IDs C and C’.

much different from the normal PSE internal auditing and quality control channels. One example is a solitary single-family residential water heater project that we sampled. PSE typically performs top-down reviews of batches of these projects to ensure that everything in the batch is correct, which limits the amount of information that needs to be in individual project files. Consequently, our initial review of the individual project file found very little useful information, and only by examining the project in the larger context of a batch were we able to review it more thoroughly.

The review team suspects that many of these difficulties resulted from the tremendous growth of the PSE EES portfolio in recent years. The latter is a complex and extremely diverse enterprise, a fact which became more apparent the deeper we investigated. The addition of new programs and third-party-administered offerings has necessitated that EES expand their systems and processes dramatically and rapidly to accommodate the increased complexity. PSE is, and will continue to be, in “catch-up mode” as they flesh out their programs, systems, and documentation to be in line with industry best practices.

The review team understands that PSE systems are generally set up for internal efficiencies, and not necessarily to be completely transparent to outside reviewers such as our team. It would be possible for PSE to spend more effort making their documentation more “user-friendly” for third-party reviewers, but the question needs to be asked of whether that would be the highest and best use of conservation resources if such reviews are infrequent, and can be dealt with on an as-needed basis.

Table 9: Project Review Sample

Program Number	Sampling Domain	Project Counts								
		2010			2011			Combined (b)		
Program Number	Sampling Domain	Total	Reviewed	Inspected	Total	Reviewed	Inspected	Total	Reviewed	Inspected
E201	Low Income Weatherization	650	6		712	5		1,362	11	
E214	Single Family Existing Exclude Weatherization									
	Energy Star Clothes Washers	21,866	25	3	17,558	10	1	39,424	35	4
	Homeprint/ Water Heat	1,742	7	1	5,592	6	2	7,334	13	3
	Refrigeration Decommissioning	6,061	44		4,729	6		10,790	50	
	Primary Refrigerator Replacement	0	0	18	601	0	18	601	0	36
	Residential EE Lighting Rebate	59	12		252	6		311	18	
	Showerheads	4,291	4		24,709	11		29,000	15	
	Space Heat	3,091	22	16	2,392	6	3	5,483	28	19
	Single Family Existing Weatherization	4,919	20	18	619	9	9	5,538	29	27
E215	Single Family New Construction*	4,695	8	1	2,129	4	6	6,824	12	7
E216	Single Family Fuel Conversion	500	7	2	280	4	1	780	11	3
E217	Multi Family Existing	221	23	21	279	23	12	500	46	33
E218	Multi Family New Construction	15	5	2	9	5	3	24	10	5
E249	Pilots (non-Home Energy Reports)	184	2		208	4		392	6	
	Residential Energy Management (REM) Total	**48,294**	**185**	**82**	**60,069**	**99**	**55**	**108,363**	**284**	**137**
E250	Commercial/industrial Retrofit									
	C/I Energy Smart Grocer	368	6	6	437	4	2	805	10	8(8)
	C/I Lighting	534	9		518	6		1,052	15	(11)
	C/I Retrofit HVAC/Other	144	5		134	4		278	9	(14)
	C/I Retrofit Industrial/Process	46	2		34	3		80	5	(9)
E251	C/I New Construction	41	6	5	42	6	3	83	12	8
E253	Resource Conservation Manager (a)	72	13	4	102	7	1	174	20	5
E255	C/I Lighting – Small Business Lighting	1,585	61	47	1,853	12	3	3,438	73	50
E257	LED Traffic Signals	3	2		42	4		45	6	
E258	High Voltage	5	2		15	4		20	6	
E262	Commercial Rebate									
	C/I Lighting	149	4	2	383	10	3	532	14	5

		Project Counts								
		2010			2011			Combined (b)		
Program Number	Sampling Domain	Total	Reviewed	Inspected	Total	Reviewed	Inspected	Total	Reviewed	Inspected
	Excluding Lighting	652	10	8	778	20	5	1,430	30	13
	Business Energy Management (BEM) Total	**3,599**	**120**	**72**	**4,338**	**80**	**17**	**7,937**	**200**	**89**
	PORTFOLIO TOTAL	**51,893**	**305**	**154**	**64,407**	**179**	**72**	**116,300**	**484**	**226(42)**

(a) Also received a detailed review (refer to Sections ***1.1*** - and2.5 Program Review: Single-Family New Constructionfor more details). The 20 projects included in this review are counted here.

(b) Projects inspected as part of separate C/I Retrofit impact evaluation are counted here. Number of these projects are denoted by parentheses.

2.3. Targeted on-site verification

2.3.1. Methodology

The flowchart in Figure 4 illustrates key steps in the targeted on-site verification process. These steps are described in more detail in this section, and additional materials associated with the process can be found in Appendix F.

Sampling

To supplement the file review process, the review team contacted a subset of 221projects to verify them through observations and customer interviews. The focus was on the on 13 of 24 program review domains that were not covered by recent/current evaluations, and where on-site inspections were likely to yield meaningful information. This small sample is not statistically significant in any traditional sense, but does help round out the comprehensive portfolio assessment, particularly taken in conjunction with other verification activities, including the detailed review of verification practices discussed in Section 3.2.

Using 2010 and first half of 2011 project samples chosen for the project file review as a sample frame, the review team employed an algorithm that accounted for (1) program saving size, (2) third-party administration, (3) measure complexity, and (4) rigor of existing inspections to allocate the inspections among programs. Details of the criteria and process for selecting sample sizes for each program domain can be found in Table 10. The final sample was adjusted slightly to favor large-savings programs in the BEM sector, except for E255 C/I Lighting, which already had a very large sample, and (2) zero out or minimize sample sizes for programs ranked "Low" (though very small samples were retained for programs with unclear inspection practices).

Certain programs and subprograms were excluded because on-site inspections were impractical or unlikely to yield useful information. One example is the residential mail-in showerhead program, in which the claimed savings for each showerhead already assumes that some number of showerheads is not installed. Another is the residential lighting rebate program, in which retailers were incented to stock high-efficiency lighting products, which consumers in turn purchased and installed in their homes. Since no record exists of where the purchased lighting went, it would have been impossible to verify them through on-site inspections.

Verifications from another evaluation

Another important adjustment was the inclusion of BEM projects that had been inspected in 2011 as part of the Commercial/Industrial Retrofit Evaluation[6] that PSE administered. This study examined lighting, HVAC, process modification, refrigeration, and other measures included in electrical tariffs

[6] Navigant Consulting, Inc. *Final Report - Commercial and Industrial Energy Efficiency Retrofit Custom Programs Portfolio Evaluation.* February 3, 2012.

E250, E257, and E258. The electrical savings portion of the impact evaluation included a sample of 42 projects. These projects were carefully inspected and analyzed by the third-party evaluator during the timeframe of our study. The evaluator ultimately concluded that these projects, in aggregate were saving slightly more electricity that PSE had claimed. Consequently, we felt justified in not performing our own on-site verification visits for these programs, but instead including the evaluation results in our overall count of verified projects. Appendix C contains the report.

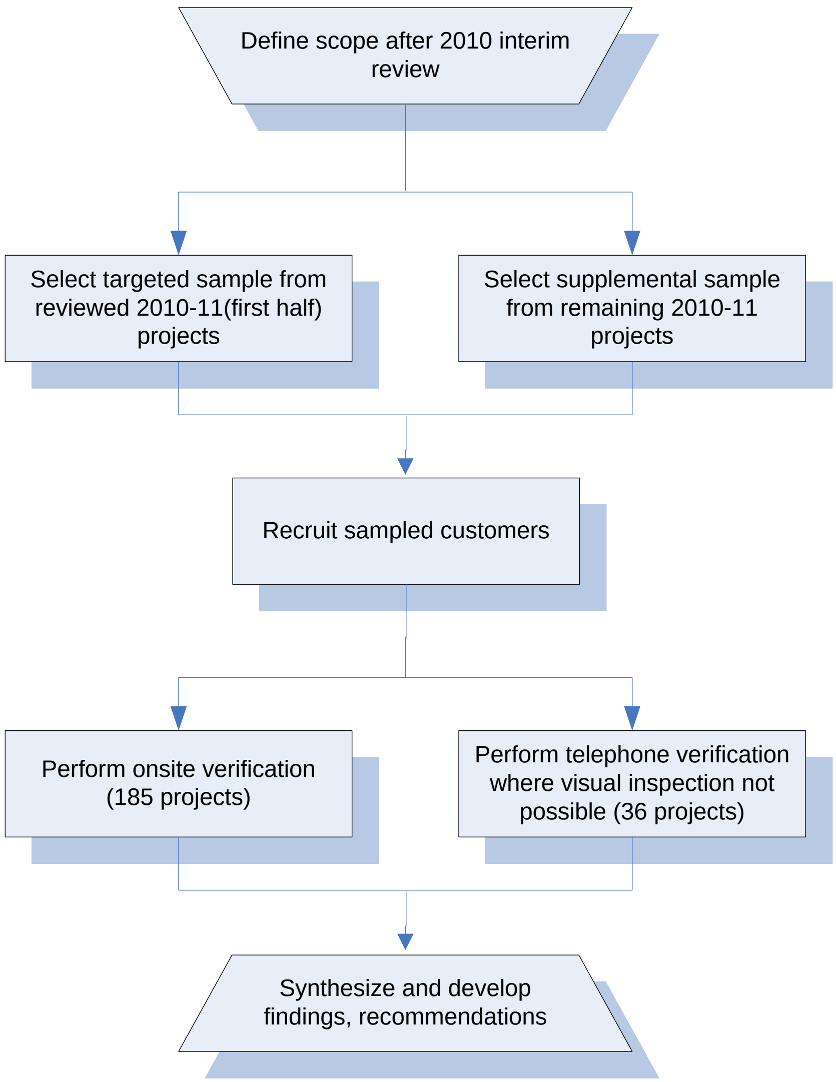


Figure 4: Overview of Targeted On-site Verification.

Refrigerator decommissioning

One procedural variant was the group of sampled homes that participated in the Refrigeration Decommissioning subprogram of the E214 Single-Family Existing Program. Since this program removed extra refrigerator units from homes, there was no item currently in place to inspect. Instead, the review team administered a telephone survey to confirm information gleaned from program records about the previous refrigerator(s). This involved sending a letter to sampled participants inviting them to call the phone surveyor at their convenience.

Field procedures

Key research questions for the inspected projects were as follows:

- Were measures associated with the sampled project installed and operational (at time of incentive, as best as can be determined)?
- If so, are the measures and their savings consistent with what was claimed (as best can be determined through walk-through/interview)?
- If not, why not? Did the program err, or was it because of a factor out of PSE's control?
- Is the participant eligible (e.g., PSE electric customer)?

The site visit provided opportunities to confirm as much as possible, through interviews and inspection, that measures associated with project were fully installed and operational.

The wide diversity of programs and projects selected for the targeted on-site verification effort made it difficult to develop prescriptive, one-size-fits-all inspection procedures. To illustrate the point, projects ranged from the installation of an efficient water heater in a condominium, to the retro-commissioning of a large downtown mixed-use high-rise. Instead, we relied on the key research questions to serve as general guidelines, around which the field surveyors crafted appropriate activities for each site. We relied heavily on the extensive field experience of our surveyors, who, with their deep knowledge of buildings and energy systems, were able to ask the right questions and work effectively with customers. Surveyors were supplied with PSE contractor badges to help customers ascertain their legitimacy.

We performed pilot testing of field procedures in December 2011, and after adjusting the procedures based on the pilot results, began a full-scale inspection effort in January 2012. This effort included extensive training to ensure that field surveyors used a consistent approach. Topics covered included:

1. Project overview
2. Level of effort
3. Steps
    a. Project file review
    b. Grouping, recruitment, and scheduling
    c. On-site visit
    d. Reporting
    e. Follow-up (e.g., gift cards for residential customers)
4. Shared files

    Site assignments / reporting spreadsheet

Pre-filled project worksheets

Project files from PSE

Example recruitment letters sent to customers

Site visit travel / timesheet / expense report / daily mileage tracker

5. Resources available to help understand complex projects (e.g., commercial new construction whole-building projects, refrigeration measures)

6. Safety, customer relations

For each selected project, we reviewed the file and set up an on-site verification appointment with customer. During recruitment, the team took great pains to minimize the inconvenience to customers, first sending a letter signed by a PSE manager to explain the verification process, and then scheduling the appointment at the customer's convenience. The letter included contact information for the PSE and SBW Consulting study managers, so that customers could call if they wanted to confirm the legitimacy of the inspection. For some single-family new construction and multi-family customers, it was necessary to have associated PSE program staff retrieve current customer contact information and make introductory phone calls to those customers. Residential customers who successfully completed the verification also received a $20 gift card to thank them for their participation.

After all of the sampled projects were inspected, the review team aggregated the results by program, examined the data, and developed overall findings based on these.

Table 10: Programs selected for targeted on-site verification

Program #	Sampling domain / Subprogram	Selection Factors: Large Saver (25%)	Third-Party Admin (30%)	Complex Measures (15%)	Inspection Practices Unclear (30%)	Sampling Tier*	Reviewed Projects Available for Sample	Final Adjusted Sample Size	Reason for Exclusion Code**
E201	Low Income Weatherization			1		L	8	-	
E214	Single Family Existing Exclude Weatherization								
	ENERGY STAR Clothes Washers				1	L	33	3	
	Homeprint/ Water Heat				1	L	9	3	
	Refrigeration Decommissioning	1	1			M	59	36	
	Residential EE Lighting Rebate	1	1				16	-	A
	Showerheads						5	-	B
	Space Heat	1	1			M	29	18	
	Single Family Existing Weatherization	1	1	1	1	H	27	27	
E215	Single Family New Construction			1	1	M	11	7	
E216	Single Family Fuel Conversion				1	L	9	3	
E217	Multi Family Existing	1	1	1	1	H	31	31	
E218	Multi Family New Construction			1	1	M	7	5	
E249	Pilots (non-Home Energy Reports)						3	-	C
	Home Energy Reports								C
Residential Energy Management (REM) Total							**247**	**133**	
E250	Commercial/industrial (C/I) Energy Smart Grocer	1	1	1	1	H	8	8	
	C/I Lighting (Retrofit)	1		1			12	-	D

Program #	Sampling domain / Subprogram	Selection Factors: Large Saver (25%)	Third-Party Admin (30%)	Complex Measures (15%)	Inspection Practices Unclear (30%)	Sampling Tier*	Reviewed Projects Available for Sample	Final Adjusted Sample Size	Reason for Exclusion Code**
	C/I Retrofit HVAC/Other	1		1			7	-	D
	C/I Retrofit Industrial/Process	1		1			3	-	D
E251	C/I New Construction	1		1		M	8	8	
E253	Resource Conservation Manager	1		1			7	-	E
E255	C/I Lighting (Small Business Lighting)	1			1	M	81	49	
E257	LED Traffic Signals						3	-	D
E258	High Voltage						3	-	D
E262	C/I Lighting (Commercial Rebate)	1			1	M	5	5	
	Commercial Rebate, excluding Lighting	1			1	M	13	13	
Business Energy Management (BEM) Total							**150**	**83**	
PORTFOLIO TOTAL							**397**	**216**	

* Selection factors were combined (factor weighting shown above) to develop score, and score was basis for assignment to Low, Medium, or High sampling tier. These got nominally assigned 30%, 60%, and 100% sampling percentages, which were adjusted slightly in several cases.

** Codes for reasons for exclusion from sampling:

A - verification impractical because of upstream nature of program.
B - verification impractical because of mail-in delivery mechanism.
C - 2011 savings based on survey/impact eval, no additional verification needed.
D - Impact eval (including site visits) was completed in late 2011.
E - Already addressed in separated detailed study.

2.3.2. Findings

Table 11 shows the disposition of the on-site verification sample. The review team exceeded the verification targets slightly, with four additional residential projects and one additional business project making the final unadjusted sample size 221 projects. To these we added the 42 on-site visits completed by the Commercial/Industrial Retrofit Evaluation, as well as the five projects we visited during the detailed review of the RCM program, for a grand total of 268 projects. The table also shows the number of projects that the review team needed to drop from the sample, because of inability to reach the customer, lack of a knowledgeable respondent, or outright customer refusal to participate, etc. Not surprisingly, residential customers were much more difficult to recruit for the inspections, evidenced by the fact that 20 of the 22 dropped projects were in the residential sector. For several of the residential programs, the review team had to expand its pool of replacement projects beyond those that had already received file reviews, and request additional project files so as to have adequate sample.

Overall on-site verification results are shown in Table 12. With minimal exceptions, the projects the review team inspected were installed and operational, consistent with the project documentation. We have described two exceptions in the Comments column of the table. Instances where measure were no longer functioning were generally because of changing customer conditions—for example, a store going out of business—and not due to mistakes made during program activities. We encountered no evidence of projects ineligible for PSE incentives or assistance. A full listing of minor discrepancies uncovered during the targeted on-site reviews can be found in Appendix G. Of the 25 discrepancies on the list, 10 occurred at residential sites, and the remaining 15 at business sites. In all cases, the review team concluded that these discrepancies were minor, and either individually or in aggregate did not materially affect the overall portfolio savings claim. Nonetheless, this list was sent to PSE for their review, so they could adjust their reported savings as appropriate.

Table 11: On-site verification sample disposition.

Program #	Sampling domain / Subprogram	Sample size	Completed	Drops
E201	Low Income Weatherization	-	-	-
E214	Single Family Existing Exclude Weatherization	-	-	-
	ENERGY STAR Clothes Washers	3	4	1
	Homeprint/ Water Heat	3	3	1
	Refrigeration Decommissioning	36	36	5
	Residential EE Lighting Rebate	-	-	-
	Showerheads	-	-	-
	Space Heat	18	19	3
	Single Family Existing Weatherization	27	27	5

E215	Single Family New Construction	7	7	1
E216	Single Family Fuel Conversion	3	3	1
E217	Multi Family Existing	31	33	2
E218	Multi Family New Construction	5	5	1
E249	Pilots (non-Home Energy Reports)	-	-	-
	Home Energy Reports	-	-	-
Residential Energy Management (REM) Total		**133**	**137**	**20**
E250	Commercial/industrial (C/I) Energy Smart Grocer	8	16*	0
	C/I Lighting (Retrofit)	-	11*	NA
	C/I Retrofit HVAC/Other	-	14*	NA
	C/I Retrofit Industrial/Process	-	9*	NA
E251	C/I New Construction	8	8	1
E253	Resource Conservation Manager	-	5**	NA
E255	C/I Lighting (Small Business Lighting)	49	50	1
E257	LED Traffic Signals	-	0*	NA
E258	High Voltage	-	0*	NA
E262	C/I Lighting (Commercial Rebate)	5	5	0
	Commercial Rebate, excluding Lighting	13	13	0
Business Energy Management (BEM) Total		**83**	**84**	**2**
PORTFOLIO TOTAL		**216**	**268**	**22**

* Completed as part of concurrent Commercial/Industrial Retrofit Evaluation. Energy Smart Grocer includes eight completed as part of this study, and eight completed under the evaluation.

** Completed as part of detailed study (see Section 2.4).

Table 12: On-site verification results by program.

Program #	Sampling domain / Subprogram	Completed	Installation and operation verified for sampled projects	Comments
E201	Low Income Weatherization	-		
E214	Single Family Existing Exclude Weatherization			
	ENERGY STAR Clothes Washers	4	Yes	
	Homeprint/ Water Heat	3	Yes	
	Refrigeration Decommissioning	36	Yes	
	Residential EE Lighting Rebate	-		
	Showerheads	-		
	Space Heat	19	Yes	
	Single Family Existing Weatherization	27	Yes	Inspected 8 homes that received the duct sealing measure as part of weatherization. The sealing for four of these homes was found to be inadequate. Though the review team felt the overall impact of these shortcomings to be insignificant, it recommends that PSE investigate their procedures and standards in this area.
E215	Single Family New Construction	7	Yes	
E216	Single Family Fuel Conversion	3	Yes	
E217	Multi Family Existing	33	Yes	
E218	Multi Family New Construction	5	Yes	
E249	Pilots (non-Home Energy Reports)	-		
	Home Energy Reports	-		
Residential Energy Management (REM) Total		**137**		
E250	Commercial/industrial (C/I) Energy Smart Grocer	16	Yes	
	C/I Lighting (Retrofit)	11	Yes	
	C/I Retrofit HVAC/Other	14	Yes	

Program #	Sampling domain / Subprogram	Completed	Installation and operation verified for sampled projects	Comments
	C/I Retrofit Industrial/Process	9	Yes	
E251	C/I New Construction	8	Yes	
E253	Resource Conservation Manager	5	Yes	
E255	C/I Lighting (Small Business Lighting)	50	Yes	For 2 of 8 "Small Business Lighting Rebate" forms, inspections found errors in Section IV, lines "d" and "e" of the form. The measure configuration in both cases was F96 T12 two-lamp fixtures being retrofitted to F32 T8 four-lamp fixtures (Sec. IV line e). The customer entered the measure inputs on line "d" of Section IV instead of line "e". The measure configuration for line "d" is F96 T12 two-lamp fixtures being retrofitted to F32 T8 two-lamp fixtures. This error doubles the claimed savings for the measure. Though the review team felt the overall impact of this error to be insignificant, it recommends that PSE investigate ways to fix this problem.
E257	LED Traffic Signals	-		
E258	High Voltage	-		
E262	C/I Lighting (Commercial Rebate)	5	Yes	
	Commercial Rebate, excluding Lighting	13	Yes	
Business Energy Management (BEM) Total		**84**		
PORTFOLIO TOTAL		**268**		

2.4. Program Review: Resource Conservation Manager

2.4.1. Methodology

During the initial project-level review, the review team sampled and examined project files for five 2010 RCM projects[7]. We found the documentation of savings to be extensive, though questions remained about the specific actions that resulted in significant savings. The team concluded that more detailed review was justified for several reasons. First, this program accounts for a significant portion (7%) of the electric portfolio claimed savings for the 2010-11 biennium, as shown in Table 13. This level of savings makes the RCM program the fourth-largest schedule in terms of electric savings out of the 16 electric schedules with claimed savings. Some RCM projects claim as much as 2 to 3 million kWh of savings for a given year.

Table 13: 2010-11 RCM claimed savings

Year	RCM claimed savings (MWh/year)	Total claimed savings (MWh/year)	RCM as % of total
2010	20,169	295,547	6.8%
2011	25,191	348,926	7.2%
Combined	**45,360**	**644,473**	**7.0%**

Additionally, while RCM program managers have instituted many commendable improvements and refinements to their savings verification procedures, a consistent on-site verification component is still lacking. Doing so is admittedly difficult, since many of the participants have numerous large, complex sites with hard-to-detect measures, such as control and behavioral changes. Lastly, since the last impact and process evaluations were performed on this program in 2007-08, the program has expanded and evolved significantly, the latter largely in response to the evaluation findings. For this reason, it was considered worthwhile to perform a simple process-type evaluation to examine how the program is doing now, particularly since this program is expected to increase in importance in coming years.

The review team randomly selected 20 projects from among the 103 claimed in 2010 and the first half of 2011. Because of review deadlines, we were unable to include projects from the second half of 2011 in this review. We used a stratified sampling approach to maximize the sampling precision. By selecting a certainty stratum consisting of the three largest projects, excluding the 26 smallest projects that collectively accounted for 1% of the electric savings, and randomly selecting 17 projects from the remainder (using separate strata for larger and smaller projects), we attained sampling precision of 18% at a 90% confidence level. This sampling precision is provided for informational purposes only, since our

[7] This review refers to sample elements as *projects*. The RCM program refers to each element of claimed savings as a *measure*. For purposes of the discussion in this section, to be consistent with the rest of the report, we refer to the program measures as projects.

detailed review was not intended to be a formal impact evaluation that provided revised savings estimates within prescribed statistical significance limits. The steps taken for the sampled projects are described below.

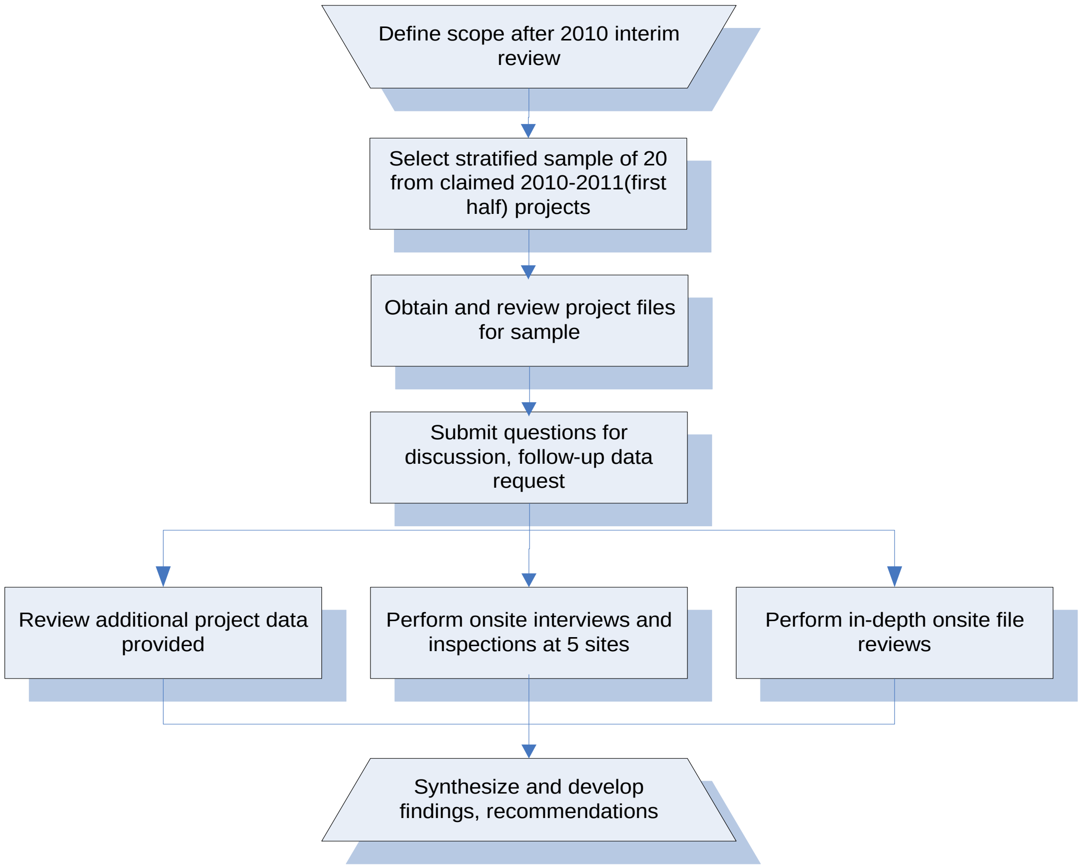


Figure 5: Overview of RCM Program Review.

Firstly, we requested and obtained full electronic sets of project files for each sampled project. These projects, as our study defined them, corresponded to the program concept of "measures," which include Start-up Incentives, Salary Guarantees, Performance Incentives, and Software Maintenance Agreements. As part of this, we also obtained full program database records for each sampled customer, so we could understand their RCM savings claim history over recent years.

Secondly, we performed a detailed review of the supporting documentation. At the highest level, reviewers attempted to trace the database savings claim back through the project reports and spreadsheets. Additionally, they sought descriptions and enumeration of specific electricity-saving actions the RCM took. In many cases, this process led to follow-up questions and missing data requests for PSE RCM program staff. In March 2012, the review team met with the latter to gain a better understanding of the detailed workings of the program and to discuss general questions about the program, as well as specific questions about particular projects. PSE provided additional information to assist reviewers before, during, and after the meeting. In one case, a reviewer examined a full hard-copy project file in PSE offices together with PSE RCM staff to gain a deeper understanding of their procedures and documentation practices.

Thirdly, the review team selected five RCM customers from among the 16 customers (with 20 projects among them) for on-site visits to meet the RCMs in person. The reviewer suggested a particular facility within the RCM's portfolio for the interview, with an aim to finding out more about a facility with especially large savings, or where the savings seemed more uncertain than at other customer facilities. During the meeting, the reviewer interviewed the RCM about their energy-saving activities and the processes by which they quantified and documented these savings. At the end of the interview, the reviewer and RCM walked through the facility in question to get a general sense of it—how big it is, who the occupants are, what energy systems it has, what the different space needs are—so that the reviewer could better understand the context and potential effect of RCM actions there. Occasionally RCMs offered suggestions for changes to program operations and communications.

Lastly, reviewers synthesized the information obtained from all of these sources, and developed brief summaries for each sampled project. These summaries describe the facility portfolio, RCM activities, the PSE basis for their savings claim, reviewer observations, findings regarding the accuracy of claimed savings, and reviewer recommendations. They can be found in Appendix H. The sampled project reports, coupled with a meta-analysis of aggregated facility data obtained for these projects, formed the basis for our general assessment of the veracity of RCM program savings. To provide further context, we reviewed previous RCM impact and process evaluations. The review team also interviewed a program manager for a similar program at another utility. The manager shared information about how their program had evolved, and their current practices for verifying and claiming savings. This input provided a useful perspective for comparing and contrasting with the PSE RCM program.

The flowchart in Figure 5 illustrates key steps in the review of the RCM program. These steps are described in more detail in this section.

2.4.2. Findings

2.4.2.1 Program overview

The RCM program is necessarily quite complex, because of the breadth of customers, facilities, and energy-saving actions that it influences. It is covered by Schedule E253 for electric savings. Below is an excerpt from the PSE 2011 Annual Report that describes the program:

> *PSE offers Resource Conservation Manager Services (RCM) to any school district, public-sector government agency, and Commercial or Industrial (C/I) customer with a minimum portfolio baseload to meet cost-effective thresholds. The RCM program targets larger customers with multiple facilities such that the cost of implementation can be recovered through savings achieved. Schedule 448, 449, 458, and 459 customers may utilize their Schedule 258 funding allocation for Resource Conservation Manager Services (RCM).*

Customers qualify for the RCM program based on their annual PSE energy purchases. A typical customer baseline for a fulltime equivalent (1 FTE) program is 20,000,000 kWh for electric only or 2,700,000 therms for gas-only service from PSE. Funding levels are prorated based on the amount of staff a customer would need to allocate in order to achieve cost-effective savings from RCM efforts.

An RCM customer employs, contracts, or designates existing staff to implement RCM responsibilities, including accounting for resource consumption, assessing facilities, recommending actions, monitoring progress, calculating savings and communicating program information to organization stakeholders.

Monetary grants include a "start-up" grant for completion of deliverables associated with building the program foundation: hiring an RCM, setting up an energy-accounting database, writing a company resource management plan, and completing facility action plans. Once start-up deliverables are complete, the customer may qualify for "performance grants" based on achieving pre-established energy-reduction targets. Salary guarantees are available for customers with a full-time program on an as-needed basis.

The RCM agreement is valid for three years. Over this time, PSE anticipates a 10-12 percent reduction in overall energy use. Savings are calculated using industry standard practices and energy accounting methodologies. Reported annual savings are a variance from the previous year. PSE may elect to renew a customer's RCM agreement in three-year increments to provide continued support and additional performance incentives.

Puget Sound Energy's RCM support program is comprised of a "menu" of services, which can be tailored to meet the specific needs of the customer. Typical RCM services include, but are not limited to, the following assistance and support:

Program Start Up

- *Designing and implementing an RCM program;*
- *Hiring or contracting a Resource Conservation Manager;*
- *Developing baselines, policies and guidelines, and facility action plans;*

Resource Accounting Software

- *Purchase and implementation of resource accounting software;*
- *Audits of existing databases to review for inclusion of all facilities, accounts, meters, etc., sufficient facility details, missing data, and overall data integrity.*

Technical Assistance

- *On-site walk-through audits to train customer staff to identify waste and opportunities for improved efficiency;*
- *Analysis and reporting of savings relative to established baseline;*

Education & Training

- *Training in fundamental concepts for designated RCM and support personnel such as custodial, maintenance, and facilities staff*
- *Educational materials for classroom or building occupant use including checklists, fact-sheets, and calculators;*
- *Training stipend to support professional development in Building Operation or Energy Management. (Training stipend is based on achieving the Building Operator Certification Levels I & II.)*

Energy Data Services

- Historical and on-going monthly PSE billing data in electronic format for import into resource accounting software;
- *Energy Interval Services for internet viewing of facility gas and electric interval meter data;*

Cash Incentives

- *"Start-up" intended to share the cost of program start up provided there is a mutual agreement that the customer will match the "start-up" funding support. Grant is paid upon satisfactory completion of "start-up" deliverables.*
- *Performance grants for customers who achieve a pre-established targeted amount of energy savings after completing their first year and "start-up" deliverables.*
- *Salary guarantee for customers implementing a program with one or more full-time RCM employees*
- *Site-based incentives for specific actions by occupants and staff which reduce energy consumption in individual facilities*

PSE is exploring ways to make RCM cost-effective for smaller customers. Shared RCM services among a group of smaller organizations have generated interest from local governments and other organizations with smaller facility portfolios. PSE efforts will continue to work with RCM consultants, customers, and other support agencies to develop this market.

The RCM program has also assisted customers in establishing ENERGY STAR Benchmarks for their facilities using EPA's Portfolio Manager. PSE will continue to help customers to identify potential targets, improve energy efficiency to meet award qualifications, coordinate the application and inspection process, and submit material to EPA for ENERGY STAR awards.

Additionally, access to energy accounting software has allowed PSE RCM customers to facilitate greenhouse gas accounting and other climate change and sustainability initiatives. The value of this service routinely exceeds those stated in the RCM program scope of work.

2.4.2.2 Review team observations

The review team's program assessment process, file reviews, discussions with RCM program staff, RCM interviews, and site visits afforded a look at program operations from the inside. Additional observations gleaned from this effort, beyond the preceding PSE-provided program description, are provided below.

General Program

- The RCM program has evolved a great deal in the past several years with process refinements, document standardization, and the addition of performance incentives.
- While each customer is unique in terms of their facilities, management, etc., they keep the program elements the same across customers, customizing the manner in which they deliver those elements.
- In recent years, customers with smaller portfolios, i.e., those with energy consumption below the threshold for RCM program participation, have been allowed to combine with other agencies to form a RCM partnership. One agency becomes the lead and enters into the grant agreement with PSE; that agency signs memorandums of understanding with the other partners to secure their participation. An example of such an RCM partnership is the collaboration between a community college and a nearby technical college.
- Keeping RCM project files organized is a continual challenge, and the increasing number of participants exacerbates the organizational challenges.
- RCMs deliver annual reports in a standardized format, usually with the savings developed through the resource accounting software Utility Manager (UM). Some industrial customers use custom spreadsheet analyses.
- Ultimately, the PSE RCM program staff are responsible for the development of portfolio savings, usually beginning with raw utility data and adjusting the baseline as appropriate for variables such as weather and occupancy. These adjusted savings are applied to savings claims and EUI benchmarks. Sites with changes in use, large scale remodeling, or similar events compromising the base and current year comparison are removed from the portfolio savings calculations.
- First time performance grants break savings targets into 3%, 5%, and 5% for each of the three years. Renewal Grants are 5%, or 1.7% per year for three years. If the 5% goal is achieved for a renewal grant before the end of the three-year term, the contract is terminated and PSE may, or not, offer the customer another renewal grant.
- PSE is working with other utilities in the region to encourage the development of RCM programs.

File Review

Twenty projects were sampled for detailed file review. All RCM program year files associated with each sampled project were part of the file review process. Overall, most projects files were reasonably accurate, but the following irregularities were noted.

- Portfolio files were not always clearly or consistently named. In a number of instances, PSE program staff located missing files or helped the evaluation team locate files in the records already sent to the review team. In general, the lack of a program-wide file naming convention system, coupled with non-standardized project file organization, made the review process slow and difficult.
- The lack of file naming conventions contributes to file version control problems.
- The application of rolling baselines is not consistent across portfolios. It would help if this process were more transparent and well-documented.
- Similarly, the decision to use, or not use heating degree data for building weather normalization in a portfolio may be applied judiciously by program staff, but the reasoning was frequently not apparent to the reviewers. There were instances where the regression analysis indicated a favorable correlation between weather and energy use but normalization was not applied and vice versa. When asked about specific projects, PSE staff could explain the logic applied to particular cases.
- Typos, data entry problems, and formula errors were found in a number of files.
- Portfolios not meeting savings goals were sometimes cleared for grant payments. Program staff made judgment calls, considering other intervening circumstances. In these instances, documentation was often lacking.
- Savings accrued in one year were sometimes carried over to the next year. Again, program staff can explain the rationale for individual cases, but the process was not transparent to a reviewer.

RCM Interviews

The review team conducted RCM interviews for five sites and were uniformly impressed with the RCM's high level of resource conservation expertise, communication skills, and enthusiasm.

- Two RCMs said PSE's Energy Interval Service an invaluable tool for researching high electrical usage, particularly after business hours.
- Two RCMs stated they played key roles in creating retrofit capital projects that might not have otherwise been accomplished even with rebates and incentives from other PSE programs. One RCM was discouraged that the current method of calculating savings for the RCM program does not give credit for savings achieved from projects that were claimed elsewhere in the PSE portfolio.
- One RCM who was familiar with another resource management software program suggested it was a more nuanced tool than UM and should be considered for the RCM program. The fact that UM is not available in an on-line version was also cited as a disadvantage.

- Another suggested creating on-line forums for RCMs so they can post their experiences, questions, obstacles they are facing, success stories, and share ideas.
- Still another suggestion was to create a forum for dialogue between RCMs with similar types of property portfolios. This could help spur more creative ideas that would be applicable to each RCM customer.

2.4.2.3 Claimed and sampled electric savings

As stated in the previous section, the RCM program claimed 45,360 MWh over the 2010-11 biennium. The average savings across 174 RCM projects is about 260,700 kWh. As Figure 6 shows, based on 2010 and first half 2011, it is a very unequal distribution, with the top 12 projects accounting for half the savings. This review examined six of those top 12 projects, as well as an additional 14 projects that overall accounted for 12,250 MWh, or 27% of the PSE claim, across 20 sampled RCM projects for 16 customers.

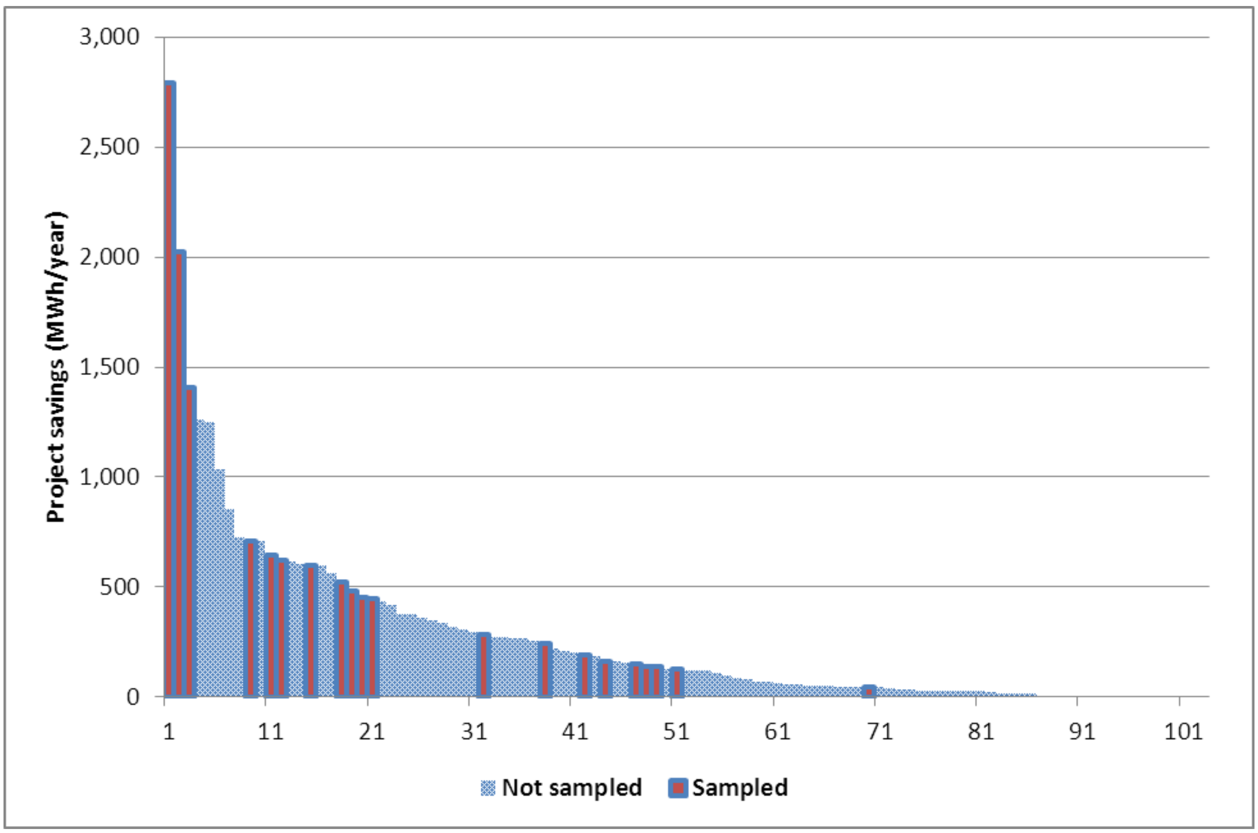


Figure 6: Distribution of 2010 and first half 2011 RCM Project Electric Savings.

Table 14: Percent Sampled RCM Savings Claimed by Customer Type by RCM Measure Type

Customer Type	Performance Incentive	Salary Guarantee	Software Maintenance Agreement	Start-up Incentive	Grand Total
City	0%	4%	0%	0%	4%
College	0%	1%	0%	12%	13%
County	0%	4%	1%	0%	5%
Grocery	0%	3%	0%	0%	3%
Office	4%	8%	0%	0%	12%
School District	42%	12%	0%	9%	63%
Grand Total	**46%**	**31%**	**1%**	**21%**	**100%**

2.4.2.4 Main issues

Overall, based on our interactions with program staff and customers, the RCM program appears to be a valuable and innovative program. It is apparent that the program is motivating large organizations to make significant changes to the way they do business, and in the process, reducing energy use significantly.

Nonetheless, the breadth and complexity of this program poses particularly daunting challenges. One is trying to understand and document RCM activities for a multitude of large customers; another is developing and applying practical means to account for program savings fairly and defensibly. Below we lay out four particular aspects of these challenges that the review team encountered:

A. The variable quality of documentation of final claimed savings

The project files that we received, though voluminous, were generally somewhat nebulous, in that there was often little savings documentation beyond site-level billing analysis. The RCM annual reports required by the program tended to be vague and quite variable in quality and thoroughness although there were examples to the contrary. Many reports addressed actions and changes at a portfolio level, rather than by facility. This meant there was no reliable record of what specific actions were taken at a given facility, and the analysis and documentation varied considerably from project to project. In 20% of the sample, we were unable to determine the source of final savings estimates. The frequent lack of dates or revision numbers on the documents made it difficult to determine final versions. In some case, reviewers had difficulties determining appropriate years for the claims. Though we understand that PSE has taken major strides towards improving their documentation, many of the problems we encountered echo findings from the RCM program process evaluation[8] performed by KEMA in 2007, when the program was relatively new. In that report, the evaluator noted that PSE did not have a systematic way

[8] This evaluation is summarized in the Appendix E under Study ID “J”.

of tracking RCM activities or program impacts. Recently, PSE has improved greatly in this regard, though there is still a lack of detail which precludes any detailed analysis or accounting.

The review team was struck by the difference in analytical and documentation rigor between, say, a 600,000 kWh/year project to install an efficient air compressor in an existing industrial facility, and 600,000 kWh/year of RCM savings. This amount of savings would be considered a very significant project in the PSE Business Energy Management programs, and corresponds to the average amount of savings for an RCM project in our sample. The BEM project might use a custom analysis with packaged modeling software, pre- and post-installation metering, and multiple inspections and QC reviews. By comparison, a similar-sized amount of RCM savings from a facility would receive far less scrutiny. Granted, documenting RCM savings is inherently more challenging, but discussions with RCMs suggested that a significant fraction of the savings they achieve results from verifiable control and hardware changes to lighting and HVAC systems.

B. Billing analysis approach may overstate savings attributable to program.

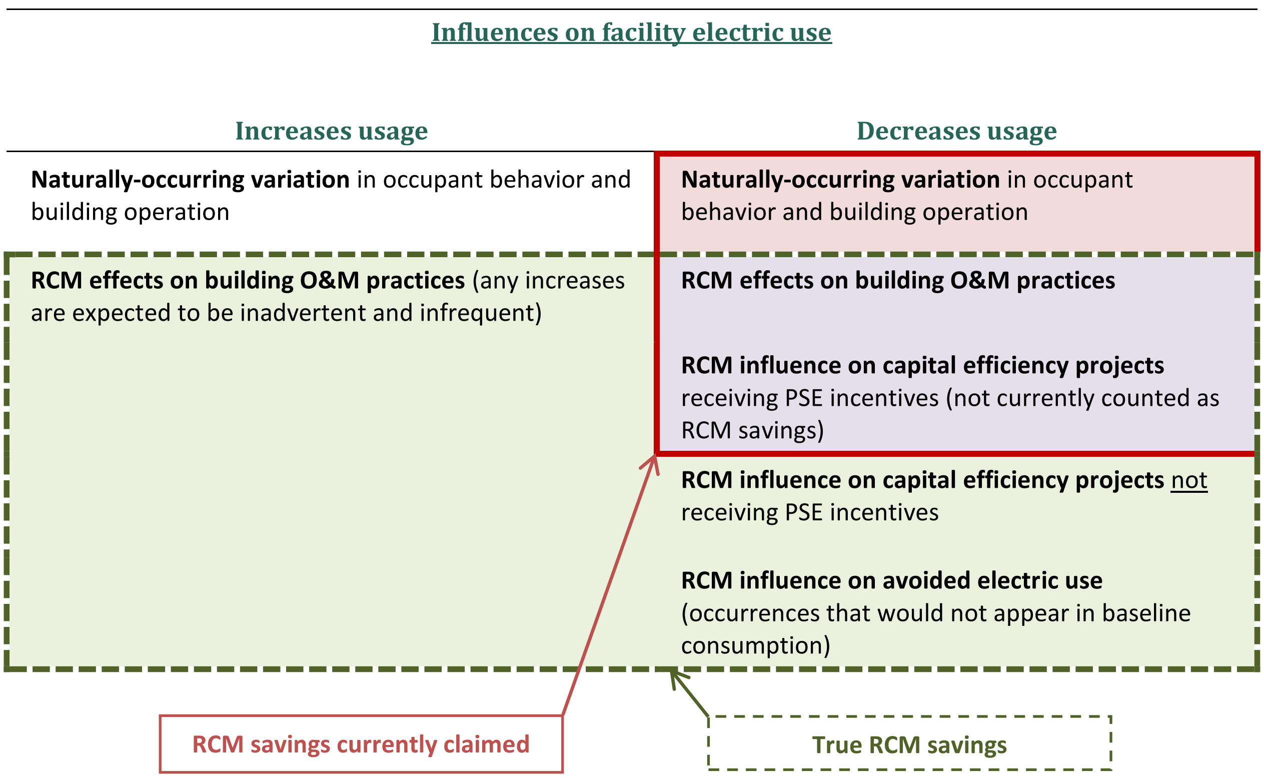
The program's current analytical framework rests on the assumption that all reductions to facility electric usage--aside from those attributable to weather, changes in utilized floor area, or PSE-incentivized capital projects--result from RCM actions and thus should be credited to the program. This may be true in some instances, but there likely are a multitude of other environmental or societal factors at play that affect energy use in a building. In this vein, we quote from the 2007 KEMA program evaluation:

> *For each case study participant, KEMA performed an ex post savings calculation using billing analysis and compared the result to PSE's ex ante savings expectation. Because many exogenous factors can affect energy use (e.g. changes to facilities use, occupancy, new facilities or old facilities decommissioned), and the high day-to-day variability in energy use in many buildings, it is difficult for a simple billing analysis to distinguish savings from "noise"…the ex post estimates were not able to take into account and adjust for all the multiple influences on resource use across the organization.*

This caveat is still very much valid. RCMs are overseeing activities at numerous facilities, and cannot be expected to be aware of every significant change in energy use, let alone the factors underlying those changes. The review team has seen strong evidence that RCMs are reducing energy significantly at the facilities under their purview, but it is a stretch to say that all the savings result from RCM actions.

Table 15 provides a conceptual framework for categorizing the various influences that can decrease, and sometime increase, electric usage at commercial facilities. The table illustrates how the current scheme for estimating RCM savings includes natural decreases in usage that would occur in the absence of the RCM, while excluding other potential sources of RCM-induced savings. The RCM program relies on UtilityManager billing analysis, while excluding facilities with increased usage compared to a base year and eliminated PSE-rebated capital projects. In essence, then the currently claimed savings includes both naturally-occurring variation in occupant behavior and building operation, as well as RCM effects on building O&M practices, as the table shows. The review team contends that to capture true RCM savings, one must exclude all naturally-occurring variation and include all RCM effects, regardless of whether these increase or decrease facility energy use. One must also include RCM influence on capital efficiency projects that did not receive PSE incentives, as well as RCM actions that avoided electrical use.

Table 15: RCM Savings Diagram



Another study, an internal impact evaluation[9] that PSE carried out in 2008, points out the challenges of meeting savings targets. This study used a methodology very similar to current program practice. The evaluation examined 45 customers who had participated in the RCM program for at least one year, and used UtilityManager data to compare base and participant year usage, while making adjustments for weather and netting out floor area changes and PSE incented measure, just as the program now does. It was not clear from the report whether facilities with negative savings were excluded from the analysis. The evaluation found that 50% of participants were falling short of goals, and that over half of customers failed to save any energy. It also found problems with claimed savings, and obtaining information necessary to make savings adjustments. Though this evaluation was completed late in 2008, the RCM program manager response, in the form of an Evaluation Report Response (ERR) was not finalized until March 2010, so it is likely that planned actions from the ERR took place during the 2010-11 study period for the third-party review, and perhaps, are continuing up through this writing.

[9] This evaluation is summarized in the Appendix E under Study ID "I".

C. Inconsistent approach to including customer facilities in savings analyses skews overall savings upwards.

Currently, claimed PSE RCM savings accrue at a facility if the net savings are positive, and if there is some evidence that RCM actions took place there. If the savings are negative, then in most cases those facilities are excluded from the analysis. This practice biases the overall savings upwards.

The review team performed an analysis of the supporting data for the sampled RCM projects to eliminate the effect of this bias. Figure 7 compares the savings for each sampled project as claimed, as well as with all negative savers included. Among the sample of projects that we reviewed, if facilities with negative savings had not been zeroed out, then the total savings claim would be reduced by about 35%, with a sampling error of ±14% with 90% confidence. This is a stratum-weighted average of the reductions calculated for each sampled measure. Generally, the more numerous, low-savings measures had the greatest reductions. More detail about the statistical analysis can be found in Appendix H. As a rule, it can often be very difficult, without extensive data collection and analysis, to understand the root reasons for why a facility's energy use increases or decreases. It was beyond the scope of this review to carry out such extensive analysis—hence, our analysis built upon PSE's initial facility-level billing analyses.

Given the way facility-by-facility analyses are carried out, there is a real risk of upward bias in savings. If a facility is a negative saver because of an unknown non-RCM effect, such as the installation of electric kilns for a new art program in a facility (a real-life example), then the facility's increase in usage will be automatically zeroed out. But if the effect goes the other way—in this example, the kilns are removed from service because of arts program budget cuts, but the RCM is unaware of this—then the reduction in electric use would be credited to the RCM program.

The review team observed inconsistency in the use of weather adjustments. The program guidelines stipulate that if there is a strong correlation between heating degree-days and facility energy usage ($R^2 > 0.7$), then the base year usage must be adjusted to post year heating degree-days.

A random spot check of twenty of facilities found that the analyses generally followed the guideline. However, gas-heated facilities, particularly schools, did not have weather adjustments applied to electric consumption in the base year, despite a strong correlation. Doing so would reduce savings at these facilities. PSE analysts believe that the correlation is due to summer load corresponding with low summer occupancy, and therefore, do not make the baseline adjustment. The review team counters that if a strong correlation exists, then the adjustment should be applied to the baseline consumption, particularly during the heating season. At the very least, this should be taken into account on a site-by-site basis, instead of applying it as a general rule to all gas-heated schools. More detailed analysis would be required to definitively determine the savings impact from making the baseline weather adjustments.

Figure 7: Effect of eliminating negative savers from RCM projects.

D. The program's discounting of savings from PSE incented measures, new construction influence, and other RCM-related avoided costs understates program impacts.

RCMs we interviewed noted that the current program design does not give them credit for the significant amount of effort they expend creating a management climate where traditional ECM projects, such as an HVAC upgrade or lighting retrofit, can happen. Once such projects are approved, they can also spend a fair amount of time making sure they are implemented properly. As it stands now, once such a project occurs, any savings associated with it are subtracted completely from RCM savings.

RCMs also noted that there is no mechanism for them to receive credit for new construction savings they help bring about. For example, if a new school is built, and the RCM advocates for energy-saving measures, such as daylighting controls or a more efficient HVAC configuration, those savings are not captured with the current base year – present year comparison. It is worth noting that both the traditional ECM and new construction measures that RCMs may be bringing about typically have long measure lives, so they would provide an extended stream of benefits compared with RCM savings as they now stand, which are only claimed for three years.

The third area where RCM impacts are understated are with avoided costs that would not show up in base year usage. One example provided to us was an RCM preventing a construction crew from heating a building unnecessarily during a renovation project.

A comparison with a similar energy manager program run by BC Hydro is instructive. They have been running a program similar in size to RCM for the last 10 years, with a mix of hardware and behavioral measures. Their program takes the opposite tack from PSE and claims savings for traditional incentivized projects, but not for behavioral effects, at least currently. Studies they have performed have found that their customers generate 55% more projects of the traditional variety if an energy manager is working with the customer. BC Hydro is currently trying a pilot approach with 20 customers, where they claim up to 4% of the “controllable” end use from the utility billing. They take raw billing data, and then their engineering staff model what is controllable—such as some HVAC systems, plug loads, switched lights—on a building-by-building basis. For example, if program engineers establish that 15% of a facility’s usage is “controllable” by the end users and/or energy manager, then then they can claim up to 4% of that 15% as savings annually.

2.4.2.5 Recommendations

A. Adjust 2010-11 RCM program savings claim

The review team’s analysis suggests that switching from the current savings analysis framework that zeroes out facilities with negative savings, to a balanced approach that sums up net savings without exceptions might reduce overall program savings by up to 35%. The 35% reduction also does not account for inconsistent application of existing protocols, such as those for weather adjustments.

It should be kept in mind that this analysis is not a substitute for a full-fledged, rigorous impact evaluation, and the calculated reduction could conceivably be offset, perhaps significantly, by two countervailing factors: (1) clear-cut instances where the negative savings can be explained by particular changes, such as the installation of new energy-using equipment, and (2) avoided costs that would not show up in the base year.

Assessing the true magnitude of a defensible adjustment would be a complex and time-consuming undertaking. Although current schedule constraints preclude such an effort, we recommend that the 2010-11 savings claims for the RCM program be reduced by some amount, informed by the review team analysis. The review team is firm in its belief that the claimed RCM savings is very likely overstated, though the magnitude of this discrepancy is uncertain at this point.

To provide some context for any adjustment, the RCM program is currently cost-effective enough that it can withstand some adjustments to the benefits and costs and still pass the total resource cost test. In 2010, PSE reported levelized benefits and costs of $0.116/kWh and $0.055/kWh, respectively, yielding a benefit cost ratio of 2.12. The net present value benefits and costs for 2011 were $6,745,907 and $2,481,435, respectively, yielding a benefit cost ratio of 2.72. Reducing the benefits by a hypothetical 17.5% (half of the reduction calculated in the review team analysis) results in a benefit cost ratio of about 2.0 for both years combined, which is still clearly cost-effective. Even reducing the benefits by 35% still produces a favorable benefit cost ratio of 1.6.

B. Re-evaluate the program sooner rather than later

Because of the uncertainties around the program savings estimates, the review team recommends performing a full evaluation of the RCM program as soon as is reasonably possible. This evaluation should focus on addressing the issues raised above. PSE’s current Four-Year Cycle Evaluation Plan provides for the RCM program to be evaluated in 2014. PSE’s intent with this and other future studies is to perform more comprehensive evaluations that will simultaneously include process and market elements, as well as impact studies, consistent with recent CRAG and UTC suggestions. It will be important that program changes regarding savings estimation methodology, be consistent with RTF guidelines[10], as well as workable for RCM stakeholders. The evaluation scope of work might also include some or all of the potential redesign areas enumerated in the next section.

C. Consider adjusting or redesigning key program elements

The third-party review of this program was not intended to substitute for a formal process evaluation. Nonetheless, the observations we made and insights we gained during the review process pointed towards some potential avenues for improving the program design. The review team is cognizant that the program operates under complex regulatory constraints, as well as other factors that we do not claim to understand fully, and keeping that in mind, we offer up these suggestions. In conjunction with evaluation mentioned previously, PSE should consider adjusting or redesigning the following aspects of the program:

- Savings calculation. As discussed above, this is a critical element. Building on the existing system, one option would be a strict adherence to using net facility savings, with clear understandings at the outset which facilities are to be included in the analysis. Exceptions would have to be very clearly documented and agreed to by both RCMs and PSE. Using EMS data for larger buildings so equipped might permit the program to be able to tell midway through a year which facilities are using more, and to collect detailed data to explain why savings adjustments should be made. The program might consider alternatives to the UtilityManager billing analysis tool that might provide participating customers with better granularity to their energy data. This enhanced resolution might improve not only RCMs' ability to track the performance of their building portfolio, but also the program's ability to document and estimate savings.

  Claiming a pre-specified percentage of the net savings might be appropriate as well, though establishing that percentage empirically would be difficult. More likely, this might have to be negotiated.

  Another option would be incorporate an approach similar to what BC Hydro is doing, and establish a cap on savings for a given building, based on what the RCM realistically could be expected to influence.

- Account for avoided costs and wider influence. As mentioned previously, a mechanism by which RCMs and the program could get credit for PSE-incented measures, new construction influence, and other RCM-related avoided costs would more fairly credit RCMs for their efforts, and might be able to boost claimable savings for PSE. Care would have to be taken to avoid double-counting savings from PSE-incented measures.

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[10] *Guidelines for the Development and Maintenance of RTF Savings Estimation Methods.* Regional Technical Forum. June 1, 2011.

The principal means by which RCMs' performance is assessed is through the portfolio EUI. The reviewers noted the EUI derived from the billing analysis software includes buildings with negative savings, while the negative savings are removed from the claimed savings. PSE should consider adjusting the EUIs to account for well-documented RCM-influenced actions--for instance, capital projects they were instrumental in developing or avoided cost actions. By this means, RCMs would receive credit for their broad range of influence on the portfolio savings. Naturally, capital measure savings would continue to be claimed by the PSE incentive program providing funding for the measure.

Past evaluations indicate that it is difficult to get the RCMs to report on site details, and the program would want to avoid burdening RCMs with too many additional reporting requirements. Nonetheless, RCMs may be more motivated to report well, though, if they are describing things that will boost their bottom line. For example, if they get credit towards their goals for avoided cost savings for new construction or more efficient new equipment, then they have reason to put the work in to develop a credible claim.

- Sampling and varying levels of scrutiny. Given the large number of facilities for a typical participant, and across the program, a targeted approach to verifying savings may be appropriate. Many participants have either a small number of large buildings that account for much of their energy use, or a large number of similar buildings (such as a school district). In either case, a stratified random sampling approach, weighted towards larger facilities or savers, may be justified. Such an approach, coupled with a rigorous assessment of sampled projects, might help improve the overall certainty around the program savings claim.
- Savings incentives. The across-the-board 3%/5%/5% rolling baseline yearly savings targets seem rather rigid considering the range of participating organizations and the amount of reasonably available savings they may have. In light of this, it might make sense to recalibrate the savings incentives, so they are less sensitive to particular thresholds, or tailored to the customer's situation. After all, an RCM could be working very hard and doing the right things, but only gets 1% savings, perhaps because the building portfolio is already fairly efficient.

  Additionally, it might be worth considering reversing the current situation where RCMs are graded based on net savings, while PSE claims savings based on a more lenient scheme where facilities with negative savings can be excluded.
- Improve communication between RCMs: Some RCMs voiced a desire for more frequent meetings or calls beyond the current annual meeting. An online forum might also be helpful. RCMs need a venue to interact and share ideas, experiences, questions, successes, and obstacles. These might also be organized so that RCMs serving particular property types (commercial office buildings, government-owned facilities, educational facilities, etc.) could share with each other.

2.5. Program Review: Single-Family New Construction

2.5.1. Methodology

During the initial project-level review, the review team sampled six projects, accounting for 11 measures, out of those claimed for 2010 for the Single-Family New Construction (SFNC) program (Tariff E215). One of these projects was part of a much larger development project that included approximately 350 homes. According to PSE, the size and duration of this project led to them negotiating specialized procedures with the developer, which PSE acknowledges were not always effective. These procedures permitted the customer to provide monthly lists of eligible equipment. The information we initially obtained for the sampled project in this development was insufficient to determine the veracity the savings. Because of the complexity and scale of this development, and the fact that it accounted for 15-20% of the 2010 electric savings for this program, the review team investigated the projects associated with this development more deeply. This included meeting with the PSE program manager, requesting and reviewing additional files for projects associated with large homebuilder, and inspecting a number of typical projects. The primary steps in this process are shown in Figure 8.

During the initial 2010 review, the review team obtained some general information about and selected examples of PSE verification procedures that allowed it to make an overall assessment. Because of the spotty documentation and the late date at which this information became available, however, the review team chose to take a more thorough look at the verification procedures, particularly those concerning third-party and commercial rebate programs. This detailed review focused on a number of key issues, such as (1) comparing how actual practices line up with stated procedures, (2) verification reporting processes, (3) how inspectors are selected and trained, (4) how inspection practices set up by contractors running third-party programs are specified and monitored, and (5) how inspection information is used to revise savings calculations (for example, how the operating hours obtained in the Small Business Lighting program are used in calculating savings). This effort differentiated between practices in place in 2010 and 2011.

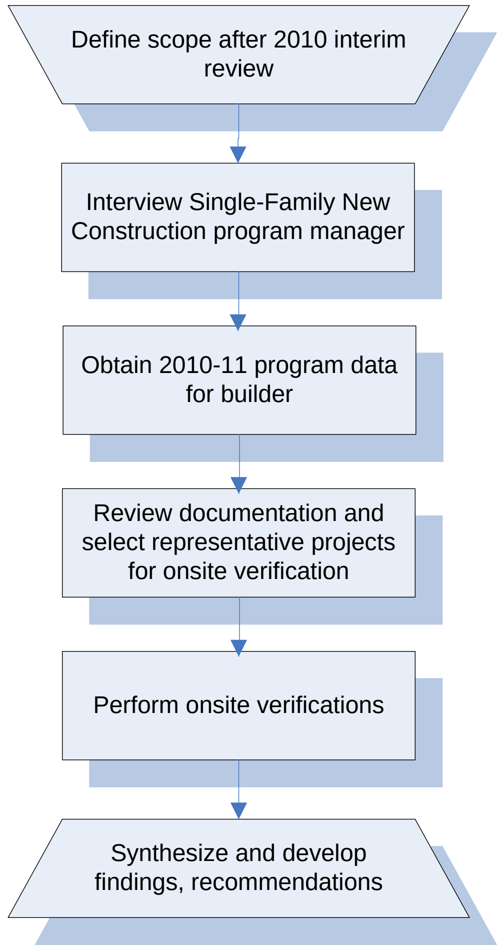


Figure 8: Overview of Single-Family New Construction Program Review.

2.5.2. Findings

The original system was implemented in order to simplify the rebate application process for the builder, as they were constructing a large number of houses and installing many energy efficiency measures in them. In 2010 and 2011, PSE paid incentives on 383 and 220 homes, respectively, that this builder constructed. Although this system was reliable, it was not consistent with how the other builders were filing their rebate applications and PSE did not want to appear to be biased toward any one builder. Therefore, in January of 2011 this builder started building ENERGY STAR homes exclusively, which are submitted through the ENERGY STAR website.

The lighting portion of the SFNC program is operated by the third-party vendor, while all of the other measures are submitted and claimed through ENERGY STAR. Since there are two different third-party vendors, the submission process is slightly different. For the lighting measures, the buyer receives the discount on-site. The third-party vendor certifies that all of the fixtures sold qualify for the PSE rebate and then they perform an internal audit of 30-50% of sites before they submit the claims to PSE with the installation address, model numbers, and fixture counts. For the ENERGY STAR processed rebates, the builder selects the model number for each claimed measure from a list of qualified equipment per measure installed at each site. PSE then logs into the ENERGY STAR website and downloads the ENERGY STAR certified utility incentive measures. The rebate processing team then looks at each file to verify the equipment type and enters the measure type, savings, and rebate amount into the PSE program tracking database.

PSE has had a policy in place since 2010 for the Quality Assurance team to audit 15% of all addresses with claimed measure savings. The audit consists of gathering all the site-specific claimed measure information, going to a site, and visually confirming all of the measure counts and model numbers against the claimed data. If a claimed measure is not found during the site inspection, the rebate for that measure is not paid. Since 30-50% of the installed lighting measures have already been audited by the third-party implementer, this results in a greater verification coverage rate and sometimes double verification of sites.

The review team accompanied PSE program staff on a site inspection of three homes claimed by the builder in question. Each site had both lighting and non-lighting claimed measures. As indicated, the PSE verification team looked at each piece of equipment claimed for a rebate and confirmed the installed model number against the claimed model number in the ENERGY STAR or third-party implementer documentation. For the three sites, the claimed equipment matched the installed equipment exactly.

The lighting portion of the program was also modified in 2011. Prior to October 2011, PSE rebated every ENERGY-STAR- qualified CFL installed at $3/unit and every energy efficient fixture installed at $20/unit. Now they provide a flat rebate of $300/house if at least 80% of the installed lighting is energy star rated. This has simplified the lighting rebate process. In the instance where the PSE QA team finds less than 80% ENERGY-STAR-rated lighting at a claimed lighting project, they send the project back to the builder to resolve the discrepancy, or they refuse to pay the rebate.

Based on the information we obtained through interviews, database reviews, and on-site inspections, the review team concluded that the savings claimed for this particular builder through the SFNC program are accurate, and should be considered completely valid.

3. EM&V Practices Review

The objective of this review was to compare evaluation, measurement, and verification (EM&V) activities associated with the portfolio with accepted industry practices. Of specific interest were (1) tracking and reporting processes, (2) measure installation verification, and (3) evaluation planning and application. This section describes the methodology we used to carry out our reviews for each of these three areas, as well as the corresponding findings.

3.1. Tracking and reporting processes

3.1.1. Methodology

In the course of reviewing PSE's 2010 portfolio claim, the review team obtained relevant project tracking database extracts and reports, as well as internal studies of these systems. The team conducted an overall assessment of database fields, their use, and accuracy of the data. This went beyond the portfolio savings review described in Section 2, which focused on verifying the overall portfolio savings numbers using the tracking data, to a more-broad-based assessment of the various ways the tracking information is used.

The review team had numerous conversations, meetings, and e-mail exchanges with PSE staff to develop an understanding of their tracking databases. Our team reviewed the flat files and Access documentation to the extent that database documentation limitations permitted.

Key files included the following:

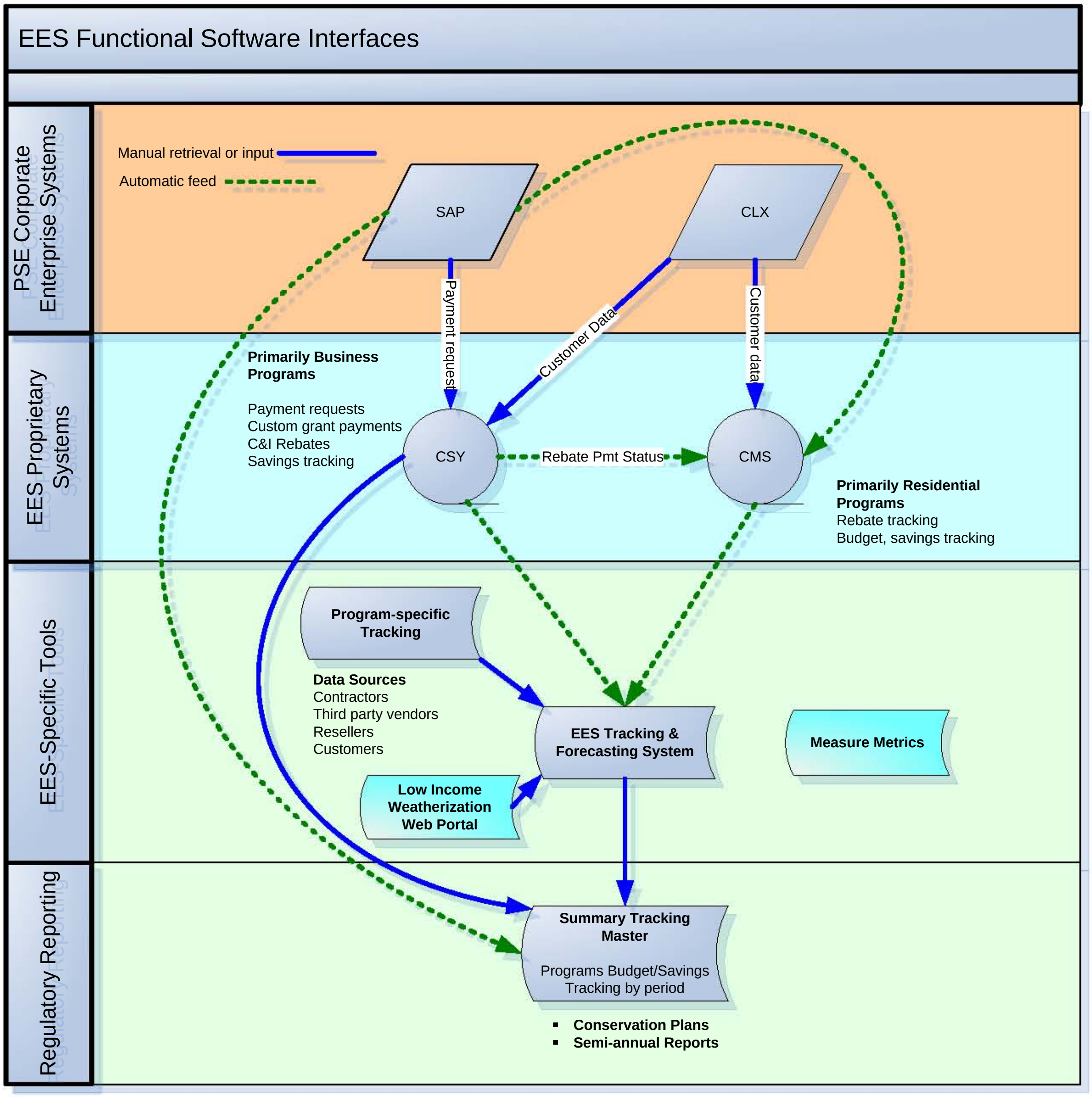
- Energy Efficiency Services Budget & Administration, Evaluation and Programs [Internal] Audit, Detailed Draft Report issued March 22, 2011(ESS Audit Detailed Draft Report w_responses.doc).
- Internal presentation discussing the current state of data quality, and potential improvements (Tracking and Reporting Improvements.ppt).
- 2010 Annual Report of Energy Conservation Accomplishments (UE-100177+EES+2010+Annual+Report+(filed+2-15-11).pdf). One note: this was supposed to contain "Appendix G: EES evaluation studies made in 2010," but it appears that appendix was inadvertently omitted from the final version made available to the public. Upon request, PSE provided this material to the review team.
- Various program reports from the cost-effectiveness workbook shown in Appendix D of the annual report (Elect - EESPgmCE2010_Bobbi2_Final.xls).

To their credit, PSE has already identified numerous areas for potential improvement. In this section, we summarize those areas and amplify some of their conclusions based on our own experiences with PSE tracking and reporting systems. This section also includes feedback based on the review team's understanding of practices from other utilities, along with recommendations for improvement.

3.1.2. Findings

Overview of Tracking and Reporting Systems

Figure 9 provides a graphical summary of PSE's tracking systems, as presented in their 2011 annual report. It is provided to supplement the discussion.



(Reproduced from Figure 3b in the PSE 2011 Annual Report of Energy Conservation Accomplishments.)

Figure 9: Energy Management Tracking and Reporting Interface.

The main systems shown in Figure 9 are described below, using modified verbiage from the Annual Report and Internal Audit:

- **SAP** (Systems, Applications, and Products in Data Processing) – The PSE SAP system is used mainly for human resources, contracting, inventory control and general accounting. EES interacts with the system through timesheets, contract/invoicing, and by assigning costs against order numbers.
- **CLX** (Customer LinX) – A proprietary system used for managing customer billing information, meter data (meter readings, ID numbers, structure history, etc.) and tracking outages. The CLX data is saved in a business data warehouse to allow for information transfer to other systems. CSY and CMS pull customer usage data and basic account information (name, address, account number) from the data warehouse.
- **CSY** (Customer SYstems solutions) – A PSE-created system with two distinct functional areas: Custom Grant Programs and Customer Rebate Programs. The system is used to track the status of Custom Grant Projects (from initial estimates to Grant Agreement to Final Payment) and to send payment request information to SAP. Payment information includes custom grants and rebates; both prescriptive and calculated for both EES sectors (Residential and Business). CSY is maintained by IT Data & Application Services team and is supported through formal change control, access controls and has system documentation.
- **CMS** (Customer Management System) – EES Customer Management System is the primary interface for fulfilling and tracking customers' interactions with EES residential programs and services. Modules include: Literature & Rebate Fulfillment, Contractor Referrals, Rebate qualifying and processing and EES Inventory Management. The CMS system has been developed over the last seven years and is maintained by an external programmer. The CMS system started as a referral tracking system and today is used for customer fulfillment, inventory management for brochures and other items for trade shows. In the near term the CMS system is adding additional functionally with reporting, forecasting and workflow tracking that warrant the system control environment to be strengthened. Currently there is no high level system documentation, data definitions, documented change control procedures and security access procedures and cross training.

The other EES systems are maintained within EES and have evolved within the last year to the level of complexity and core business reliance that a comprehensive IT roadmap and more rigorous IT standard practices and documentation are needed. Currently, the IT roadmap consists of diagrams and does not entail a comprehensive view of business functionality needs and IT technology capabilities so that management can continue to make informed decisions as new information is gathered.

The Residential Tracking Access database became fully operational in July of 2010. It is the master database used to forecast and report savings for all residential programs.

Measure Metrics is an Access database implemented in 2008 and is the official archive of measure savings for Regional Technical Forum (RTF) deemed saving measures and PSE deemed savings amounts. These systems have access controls, and change controls, though there is no documented high level system documentation and while some cross training has been performed, more comprehensive training is still needed. The addition of high level system documentation that describes the key functions and architecture of how these systems would minimize the risk of down time in the event that key individuals can no longer support the system.

Currently, none of these systems can interact with each other, potentially resulting in discrepancies in information contained in the databases.

- **Summary Tracking Master** – This is a spreadsheet that is used to compile all savings and all financial data relative to EES operations in both sectors (Residential and Business). The EES Master is used to generate all periodic reports (internal and regulatory), and is developed using exported data from the various databases.

PSE also provided the following summary of these systems in the *Energy Efficiency Services Budget & Administration, Evaluation and Programs Audit* document:

> *The Residential programs are administered both internally and externally by outside vendors. EES uses four main systems to forecast, process and pay vendors, customers and contractors. EES uses PSE's main customer LinX system (CLX) for eligibility and SAP for payments. In addition, EES uses two custom built system: 1) Customer SYstems Solutions (CSY) to track custom grant programs and pay customer rebate programs and 2) Customer Management System (CMS) to manage the interface with residential customers. The long term plan for the CMS system is for it to become the comprehensive system to maintain all EES program savings and upload data from our external program administrators.*

PSE Internal Review

The internal presentation on tracking and reporting improvements listed in Section 3.1.1 stems from an evaluation group assessment of the data needed for performing cost-effectiveness calculations. Key observations and suggestions from this review include the following:

1. Naming conventions are inconsistent.
2. Critical fields are missing.
3. "Program year" or "year savings claimed" information needs to be added.
4. A unique tracking number should be used for every entry.
5. Corrections should be done at the measure level for specific projects, not in bulk.
6. Tracking spreadsheets are not a sufficient or efficient way of tracking program data--database management is critical.

7. Good practices in tracking and reporting must be replicated by PSE third-party program administrators, using PSE-mandated reporting/tracking requirements.
8. Every program must report the same fields.
9. Measure cost data reporting can be improved by:
   - Providing on a measure, rather than program, basis (such as with the Energy Smart Grocer program.
   - Consistently reporting costs (for instance, either applying invoice amounts or deemed values from Measure Metrics, but not both for the same program).

More globally, the first recommendation listed in PSE's internal audit states the need to develop more rigorous IT standard practices and system documentation for the CMS system, and Residential Tracking and Measure Metrics access databases. The audit further recommends that EES develop:

1. An overall roadmap.
2. High-level system documentation.
3. Data definitions.
4. Documented change control procedures that ensure segregation of duties between developing code and moving it into production and user testing and signoff.
5. Documented security information and a procedure for performing periodic access reviews.
6. A comprehensive cross training plan.

Best Practices

After assessing PSE's internal review and comparing it with the data products and practices that we encountered during our efforts, the third-party review team reached very similar conclusions. We affirm PSE's own findings at all levels. Based on the team's experience, and its review of the National Energy Efficiency Best Practices study[11] that reviewed "best practice" programs nationwide, it is vital to have the following elements in a tracking and reporting system independent of program type:

[11] The Energy Efficiency Best Practices Project sought to build off industry experience and knowledge by establishing a structure for analyzing and communicating best practices to help meets today's complex energy challenges. The project uses a benchmarking methodology to identify best practices for a wide variety of program types. This study is managed by Pacific Gas and Electric Company under the auspices of the California Public Utility Commission in association with the California Energy Commission, San Diego Gas and Electric, Southern California Edison, and Southern California Gas Company (eebestpractices.com).

Residential

1. Defining and documenting data requirements

    a. Define and identify the key information needed to track and report early in the program development process to measure success.

    b. Develop accurate algorithms and assumptions on which to base estimates of savings.

    c. Carefully document the tracking system, using detailed process flow diagrams for guidance, and provide manuals for all users.

    d. Assure that tracking systems are intuitive, straightforward, integrated and comprehensive.

    e. Integrate marketing, customer, audit, and impact data.

    f. Design the program tracking system to support the requirements of evaluators as well as program staff.

    g. Design databases for long-term strategy and use to be scalable to accommodate changes in program scope.

2. Use of database and tracking systems

    a. Establish system to collect/track these data over time.

    b. Conduct regular checks of tracking reports to assess program progress and make corrections to ensure success.

    c. Minimize duplicative data entry by linking databases to exchange information dynamically.

    d. Build in real-time data validation systems that perform routine data quality functions.

    e. Automate routine functions such as monthly reports.

    f. Make the audit recommendations, including energy saving potential, part of the program tracking database.

    g. Track vendor activity and measure volume where relevant.

    h. Track market transformation program qualitative benefits and measures related to spillover effects, along with direct savings impacts.

Non-Residential

1. Defining and documenting data requirements

    a. Integrate all program data, including measure-level data, into a single database.

    b. Integrate or link with other appropriate systems such as cross-program databases, customer information systems (CIS) and marketing or customer relationship management (CRM) systems.

c. Use automated or otherwise regularly scheduled notification to achieve close monitoring and management of project progress.

d. Define and identify the key information needed to track and report early in the program development process.

e. Develop accurate algorithms and assumptions on which to base estimates of savings.

f. Design databases to be scalable to accommodate changes on program scope.

g. Use the Internet to facilitate data entry and reporting for private-sector market actors.

h. Build in rigorous quality control screens for data entry such as minimizing duplicative entry.

i. Carefully document the tracking system and provide user manuals; use detailed process flow diagrams.

2. Use of database and tracking systems

   a. Use electronic application processes, workflow management and Web-based communications.

   b. Use incentive commitment tracking.

   c. Allow program managers to generate or automate standardized reports.

   d. Use databases that fully integrate with cross-program energy-efficiency program information systems.

   e. Track vendor activity.

   f. Conduct regular checks of the tracking reports to assess how the program is working and make program corrections to ensure success.

   g. Track and utilize contractor and equipment information that aids in analyzing and reporting actual installed efficiency.

   h. For programs with proactive marketing efforts, track program prospects early and drive program intervention around major equipment-related events.

Overarching elements

1. Defining key information needed to track and report program progress

   a. Any applicant or contractor level information for their use, too.

   b. Program and project level tracking.

   c. Automate critical program level reports.

2. Carefully document tracking systems

   a. Data dictionary.

   b. Process flow diagrams.

c. Easy to use at all levels.

3. Integrate all program data

   a. With cross-program energy-efficiency program information systems.

   b. Including measure-level data, into a single database.

   c. Link with other appropriate systems such as cross-program databases, customer information systems (CIS) and marketing or customer relationship management (CRM) systems.

4. Data quality

   a. Conduct regular checks of the tracking reports to assess how the program is working and make program corrections to ensure success.

   b. Minimize duplicative data entry by linking databases to exchange information dynamically.

   c. Build in real-time data validation systems that perform routine data quality functions.

   d. Build in rigorous quality control screens for data entry such as minimizing duplicative entry.

Recommendations

Many of the challenges that the review team encountered obtaining tracking system data and documentation must be viewed in the context of the tremendous growth of the PSE EES portfolio in recent years. EES budgets have increased over six-fold since 2003. At that time, the CSY database sufficed to track EES activities, though since then, the addition of new programs and third-party-administered offerings has required that EES expand their tracking systems dramatically and rapidly to accommodate the increased complexity and transaction volumes in the 2010 portfolio. EES has provided evidence that its management has foreseen this need, and has begun upgrading their systems.

That said, drawing upon the information gathered from PSE's internal documentation, review team observations, and from industry best practice guidelines, the team identified a number of actions PSE can take to move their tracking and reporting systems in line with industry best practices. These actions are discussed under each of the four overarching elements listed in the previous section:

1. Define key information needed to track and report program progress

   PSE database activity occurs over a patchwork of systems. Some of these databases are partially documented. As the program activity and evaluation efforts increase, the team recommends that PSE develop new systems or enhance existing systems to strategically address its data needs. These enhancements should include incorporating additional data fields, such as contractor information, project milestones, including inspections, and other features to enable PSE to be in line with best practices. This will include reviewing systems to ensure that all programs—both PSE internal and third-party-administered programs, report the same fields, as necessary. These common fields should be reported in a consistent manner--i.e., with the same number of significant digits, same number of columns, etc.--so reports on cost-effectiveness or other metrics can be developed easily and accurately. Our review found critical fields, such as measure life and incremental/total measure costs, missing from some reports and from the Measure Metrics database as well. The review team also found that savings and incentive verification for all programs (such as the E214 single-family existing residential rebate program) does not have the same capabilities as other program reports. A significant reason for this is that many of the residential programs have other stand-alone methods of tracking projects, such as a separate database or spreadsheet. Standardizing data fields and reports will help ensure that every program meets the reporting objectives. Our understanding is that PSE is working to connect the stand-alone approaches to improve their functionality and consistency. The CSY database will also be able to improve reporting functionality so that data can be more useful.

Since Measure Metrics is a critical part of the reporting system, the team recommends that Measure Metrics data fields be clearly identified and properly defined. This includes (a) using measure ID as a unique identifier, instead of measure name, (b) fully populating incremental measure cost and effective useful life data for all deemed measures, and (c) indicating when Measure Metrics incentives can be overridden subject to caps or the measure being used in a direct-installation situation[12].

2. Carefully document tracking systems

   Recently, PSE compiled a rebate and incentive processing manual for residential programs. This document describes steps for entering data into the tracking system and CLX to ensure customer is eligible for a program. This is a good starting point for helping internal teams--as well as external ones, such as program evaluators--understand the use of the tracking systems. Additional documentation should be developed to ensure all properly use the tracking systems and understand its scope and limitations.

3. Integrate all program data

   PSE has several semi-independent data systems in place. One example is Measure Metrics, the comprehensive database for tracking savings histories for all deemed measures. This database, however, is not dynamically linked to program tracking databases. If there is an update to a measure, such as a change in deemed values or sunset date for expired measures, then this linkage must be done manually. The review team's understanding is that PSE has already identified this as an important priority. It has been working on this dynamic linkage, and hopes to have it completed by the end of 2011.

   In addition, the customer relationship, incentive payment, and eligibility checks are all done in different systems. Finally, the reporting of programs is fed manually to the EES Master, which is a spreadsheet. The EES Master, ideally, would be a comprehensive database that is dynamically linked to the other systems.

[12] PSE modified Measure Metrics to accommodate this third recommendation in September 2011.

4. Data quality

   It is unclear to the review team the status of data quality functions that are built in to the PSE systems. However, the team encourages fully implementing the data quality features described in the best practices, such as data validation and control screen functions, to the full extent possible.

Our hope is that implementing these recommendations will help PSE ensure a high level of data quality, and enable accurate reporting of savings and cost-effectiveness with a minimum of effort.

3.2. PSE measure installation verification

An initial review of PSE measure installation verification processes was completed as part of the 2010 Interim Report, with a focus on PSE implemented programs and internal procedures for measure installation verification. A more detailed review was subsequently conducted in early 2012 to examine verification procedures related to third-party program implementers and the commercial rebate program, since they were not documented clearly for the third-party 2010 review. These programs were not formally examined in the initial review. The flowchart in Figure 10 illustrates key steps in the reviews.

3.2.1. Initial Review

3.2.1.1 Methodology

Measure installation verification for the purposes of this report is defined as the process of identifying that the applicant claimed measures are properly installed and delivering the savings the PSE program portfolio reports. The steps necessary for this can include:

- Having a verification and inspection guide by program and by measure, as necessary
- Checking for applicant, project, and measure eligibility
- Conducting pre- and post-inspections
- Documenting verification results appropriately

To understand how PSE's measure installation verification practices for the 2010 program year, the review team used interviews and reviews of relevant procedural documents and example project files to develop a sense of how programs are verifying that measures were implemented properly and are yielding energy savings. We collected and reviewed the quality of the verification documentation, which included invoices, manufacturer's cut sheets, photos, inspection reports, and sampling procedures, etc., and assessed whether it was adequate.

The verification review was done in conjunction with the portfolio savings review described in Section 2. In order for the team to identify if PSE properly reported savings in the annual conservation report, the team also investigated PSE's verification practices. The methodology incorporated for that effort overlap with this portion of the review. Relevant materials included the following:

- Documented verification processes
- Inspection and verification reports for sampled projects
- Tracking and reporting data fields used for confirming verification
- Interviews and responses of PSE staff

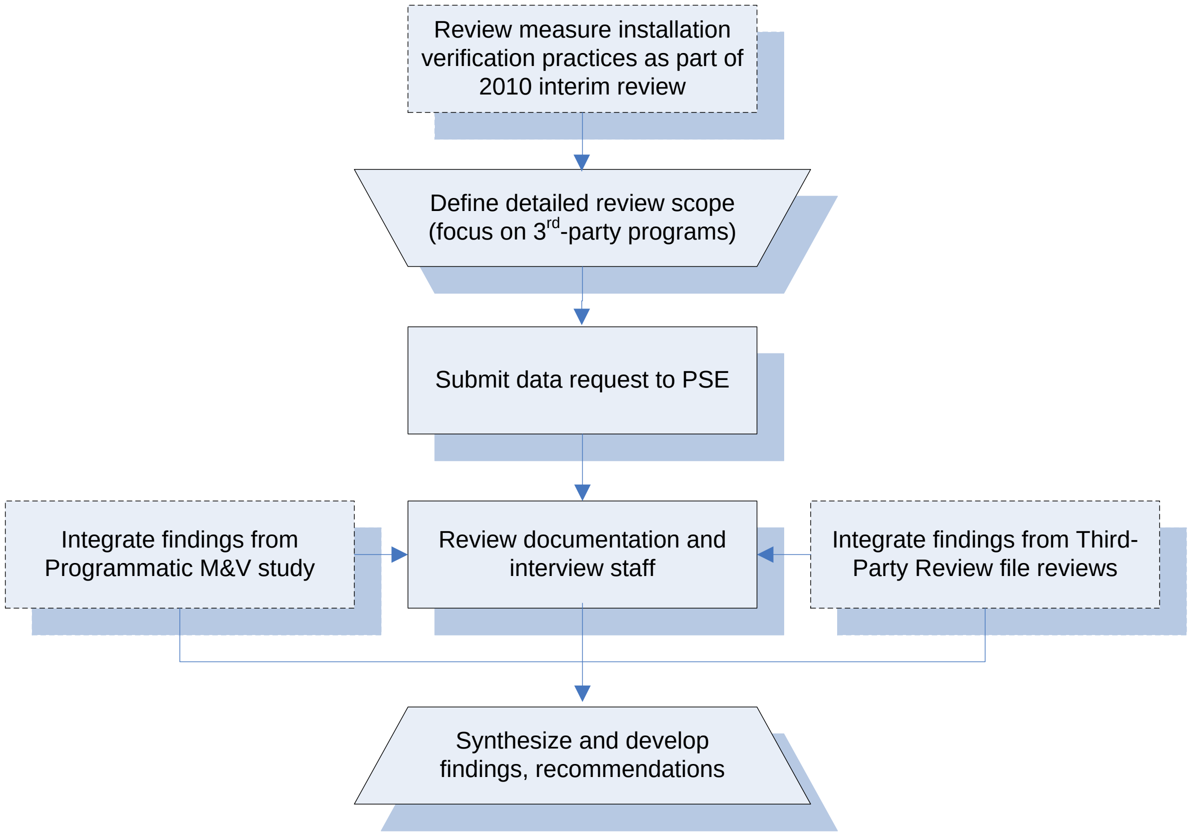


Figure 10: Overview of Measure Installation Verification Review.

Key files reviewed include the following:

- A summary of verification processes, with brief descriptions of the various steps and sampling strategies for each residential and business program/measure.
- REM rebate processing manual provides the details on data entry and how to review a single family rebate.
- Various project inspection and calculation forms, including ones for gas boiler, geothermal heat pump, HomePrint, heat pump lockout, and heat pump water heater measures. Also included in this group was a listing of Small Business Lighting projects inspected in 2010.

3.2.1.2 Findings

Best Practices

Relevant best practices for quality control and verification, as drawn from the National Energy Efficiency Best Practices study[13], are summarized below:

1. Generally program portfolios should have overarching guidelines for verification needs. Elements to consider when developing these guidelines include:
    a. Consider administrative cost in designing the verification strategy.
    b. Build in statistical features to the sampling protocol to allow a reduction in the number of required inspections based on observed performance & demonstrated quality of work.
    c. Tailor measurement rigor, including the use of sampling, to each project's contribution to the cumulative uncertainty in estimated savings for the program overall.
    d. Use a verification method capable of confirming measure and installation quality.
2. Inspection strategy may vary by measure and/or program. Some of the following are recommendations for putting best practices in this critical step in program implementation:
    a. Obtain a good random sample of vendor and measure types.
    b. Always inspect the first job submitted by a new vendor, depending on program type.
    c. Pre-inspections for large or uncertain impact projects such as those with highly uncertain baseline conditions that significantly affect project/program savings.
    d. Clearly define post-inspection rigor and quantity by cost-effectiveness considerations .
    e. Modify procedures based on results from an initial set of inspections early in the implementation process.
    f. Require post-project inspections and commissioning for all large projects and projects with highly uncertain savings which may include performance verification, especially for projects involving controls.
    g. Ensure inspectors have plenty of hands-on experience.
    h. Ensure that inspectors have adequate training in identifying and explaining reasons for failure.
    i. For residential new construction, require the builder or builder's representative to be on-site during inspection.

[13] Refer to Footnote 11.

3. The actual documentation of savings, or verification, should employ these best practices:
    a. Plan to rely on third-party inspectors for residential new construction for quality control over the long term.
    b. For residential new construction, recognize the different inspection needs of experienced builders and builders who are new to the program.
    c. For non-residential new construction, tie to full building occupancy.
    d. Verify accuracy of rebates, coupons, and invoices to ensure the reporting system is recording actual product installations by target market, such as lighting.
    e. Conduct in-program measurement/impact evaluation for the very largest projects or those with uncertain impacts.
    f. Conduct either in-program measurement or measurement through an impact evaluation on the very largest projects and those that contribute most to uncertainty in overall program savings.

PSE Practices

After reviewing PSE's verification practices and comparing them with best practices, the review team concluded that PSE's efforts are satisfactory, as we did not find any significant issues in PSE's reporting of energy savings. This mostly stems from good verification practices, including the following:

- Measure Metrics database is used to tracking savings, incentives, measure life, and incremental measure costs for all measures.
- Comprehensive verification checklists are employed for some rebated measures.
- All custom grants are pre and post-inspected.
- Very large projects undergo multiple levels of review.
- Third-party programs generally inspect at least one project per contractor.
- Costs are taken into consideration in prioritizing verification needs.

Nonetheless, the review team observed some current PSE practices that could potentially be enhanced. These areas of improvement are, for the most part, already being considered by PSE and/or their consultants.

1. Tracking and reporting documentation
    a. The team did not receive a complete extract of the tracking system to be able to fully investigate this topic, but certain elements seem to be missing from some programs.
    b. Some processes, such as inspections, are not tracked in one place. Some inspections, such as those for Small Business Lighting, are tracked in a spreadsheet. This practice may result in issues with the following:

- If a project is pre-inspected, then recognizing if it is selected for a post inspection.
- Project ID numbers not appearing on the spreadsheet.
- Recording discrepancies identified during the inspection, verifying that they are corrected, and then transferring that information to the CSY payment database correctly.

c. Project files might not match the tracking system; some critical file information is not in the tracking system.

2. Verification

a. General comments

- Some programs, such as Residential Space Heat and Water Heat, have detailed verification procedures, while others do not.
- Documentation of how to do an inspection and criteria for verifying quality were not available for review.
- Methods for verifying efficiency levels and actual efficiency and size levels are not always clearly documented.
- Methods for conducting quality control are not always clearly documented.

b. Small Business Lighting programs

- The sampled projects show only quantities being verified, but not if the fixtures, lamp, and/or ballasts qualify for the program.
- Verification procedures include collecting operating hours on a site basis (not a measure basis). It is not clear if these hour values are used to update reported electric savings or not.

c. RCM program

- The documentation of when and how much incentives and savings are claimed is not clear.

d. Third-party programs

- The review team did not receive process information or documentation on verification processes for third-party programs.

PSE is in the process of developing an M&V framework that defines policies, guidelines, protocols, and M&V processes, mostly from a program implementation, rather than evaluation, perspective. This framework will help define the inspection and verification processes, according to best practices.

Recommendations

The review team recognizes that PSE is continuing to improve its verification practices to bring them in line with best practices. These efforts dovetail with PSE's work developing an M&V framework to document M&V policies, protocols, guidelines and processes and additional QC/QA reviews to be provided by outside parties. Based on the review team's investigation of best practices and comparison with current PSE practices, the team has identified several key areas that could most benefit from improvements. The recommendations are as follows:

1. Integrate PSE Databases

   PSE has multiple databases and spreadsheets that provide the data necessary to fully verify a project's installation and savings. These multiple platforms can result in confusion on what verified savings values are, particularly because updates in some cases do not propagate between databases automatically. The review team recommends PSE to continue its process of completing--potentially by end of 2011--the dynamic linking of the Measure Metrics, CSY, CMS, and other database systems. This may also include adding project verification information into the centralized system, thus minimizing or eliminating the need for ad hoc tracking spreadsheets used by individual programs. This recommendation overlaps with those made in the Tracking and Reporting Section (3.1.2), but savings verification and savings reporting are very closely linked.

2. Complete Verification and Inspection Process Documentation

   Many savings verification and measure inspection processes are currently not documented, and lack clear guidelines. According to PSE staff, program engineers and inspectors (QA specialists) are receiving training and have the expertise, but improved documentation is critical to achieve consistency and rigor. As PSE enhances this documentation, it should be accomplished in concert with the development of the M&V framework. Moving forward, this documentation ideally will be developed in the program design phase for new program elements.

   Some program/measure documentation appears comprehensive, and includes installation quality metrics. Similarly, some programs have more rigorous and documented procedures for sampling for inspections. Such instances should be generalized, so that there is consistency within and across program groups, which should be evident not only to internal verification teams, but also to program participants.

   Following on the program-specific findings noted in the previous section, the RCM program would benefit from clear guidelines on project file documentation to ensure that appropriate savings and incentive calculations are done on all projects. The Small Business Lighting program might consider documenting equipment qualification, as well as clarifying the use of collected operating hours in savings calculations.

3. Enhance and standardize verification for third-party programs

Third-party program implementers do not appear to have any PSE-imposed guidelines or requirements for their verification processes. Nor does PSE have a designated QC/QA lead tasked with overseeing third-party programs. Consequently, the review team recommends that PSE:

- Require third-party programs to document their verification processes.
- Establish minimum requirements for on-site inspections.

- Fully integrate third-party reporting requirements to be consistent with PSE requirements.
- Conduct randomly-sampled, internal verification of third-party projects.

Implementing these recommendations has the potential to make PSE an industry leader in carrying out thorough and proper verification activities. This will likely lead to accurate reporting of energy savings on a consistent basis.

3.2.2. Detailed Review

The initial review focused on PSE implemented programs, and did not examine third-party-administered programs or the Commercial Rebate program, the latter of which is implemented by both PSE and third parties. Therefore, the review team conducted a more detailed assessment of how PSE oversees the measure installation verifications related to third-party programs and the Commercial Rebate program.[14]

3.2.2.1 Methodology

To understand verification procedures, the review team identified the list of third-party programs and commercial rebate program elements. The following information and documentation was requested for program years 2010 and 2011:

- Inspection rate and pass/fail rate (by measure, if applicable)
- Total number of projects (by measure, if applicable)
- Inspection goals (e.g., percent)
- Inspection/verification field forms
- Inspection criteria (i.e., how are projects chosen for inspection)
- Documentation of inspection and application review procedures
- Verification field forms

In addition, relevant information obtained from the projects file reviews and targeted on-site verification efforts (discussed in Sections 1.1 and 2.3, respectively) was brought into this review. Early findings from this review were shared with the file review and on-site verification teams so that they

[14] Under a separate contract, members of the review team from KEMA, Inc. have been working with PSE on two related items: (1) developing an M&V framework and policies, protocols, and procedures for M&V (as part of the settlement agreement) that defines the requirements for verification and (2) formalizing the PSE verification needs and verification team. However, in these instances, the review team still observed a gap in these areas and wanted to further investigate PSE's practices in the 2010 and 2011 program years.

could adjust their data collection approach to shed more light on PSE verification activities, had opportunities arisen.

3.2.2.2 Findings

Table 16 provides an overview of the third-party programs examined by the review team, and whether site inspections are conducted, and if so, by whom (i.e., the third-party implementer and/or PSE staff). Most third-party implementers conducted site verifications to inspect installed measures. For the Low Income Weatherization and Multi Family Existing programs, PSE also conducted tandem visits along with the third-party staff conducting the verification to observe the verification visit. No independent PSE verifications of projects were conducted for these third-party programs.

Table 16: Summary of Verification Visits for Third-party Programs

			Site Verifications Conducted?	
Code	Program Name	Implementer	3rd Party Staff	PSE Staff
E201	Low Income Weatherization	Low Income Weatherization Agency	√	√
E214	Single Family Existing			
	ENERGY STAR Clothes Washers	PECI		
	Ductless Heat Pump	NEEA	√	
	Manufactured Homes – Duct Sealing	UCONS	√	
	Refrigerator Recycling	ARCA		
	Weatherization	ECOS	√	
E217	Multi Family Existing	ECOS IQ	√	√
E262	Commercial Rebate			
	Green Motor Rewind	Green Motors	√	
	Premium HVAC Service	NEEC	√	
	Energy Smart Grocer	PECI	√	

As identified in the initial review, an overall approach to verification should be assessed on a program portfolio basis. Site inspections are the most rigorous approach to verifying that applicant-claimed measures are properly installed and delivering the savings reported by the program. Site inspections, however, are also the most costly approach to quality assurance and verification. Measurement rigor should be tailored to program contribution to the cumulative uncertainty in estimated savings. Therefore, not all programs and program components necessarily require site inspections.

Two of the third-party programs did not conduct on-site verification inspections, namely the ENERGY STAR Clothes Washer Program and Refrigerator Recycling Program. The ENERGY STAR Clothes Washer program implementer conducted paper verifications and application reviews to ensure customer and clothes washer eligibility. Deemed savings were used to calculate program savings based on the applications submitted. Although the program's overall contribution to PSE 2010-11 portfolio savings is relatively small (about 1%), it is a relatively expensive program to implement and may warrant some type of verification procedure.

No site inspections were conducted for the Refrigerator Recycling program due to program design. This program removes the existing old refrigerator and installs a new energy efficient refrigerator. One would expect that customers would complain if no refrigerator was installed. Furthermore, the most significant concern related to the removal of the old refrigerator is that the unit is disposed of properly and not being returned to a secondary refrigerator market. All sites were pre-inspected to confirm eligibility.

Table 17 provides an overview of the Commercial Rebate program components that PSE implements. Half of the program components have specific site verification inspection goals consisting of a random selection of sites. For the remaining programs, targeted site inspections occur if model numbers submitted are missing, in order to verify the equipment type and eligibility, or if there are any concerns about the application.

Table 17: Summary of Verification Visits for Commercial Rebate Program

Code	Program Name	Implementer	Site Verification Inspection Goals?
E262	Commercial Rebate		
	Cooking Equipment/Dishwashers/ Refrigerator/Freezers	PSE	
	EC Motors	PSE	√
	Hospitality	PSE	√
	HVAC Retrofit (HE Heat Pump and AC)	PSE	
	Lighting Mark-Down	PSE	√
	PC Power Management	PSE	
	Portable Classroom Control	PSE	√
	Premium Efficiency Motor	PSE	
	Programmable Thermostat	PSE	
	Vending Misers	PSE	
	Variable Speed Drives	PSE	√
	Washing Machines	PSE	√

Other types of site inspections and quality control activities may also occur, such as:

- Cooking Equipment/Dishwashers/Refrigerators/Freezers program performs random site inspections, sometimes when a member of the PSE Rebate group is near that particular site, and typically after payment of the rebate.
- HVAC Retrofit program conducts 100% pre-inspection to verify pre-existing conditions. A small number of random post-installation inspections are conducted, but there are no formal inspection goals.
- Vending Miser program is unique in that it requires installers to provide a photo as proof of installation. Therefore, no follow-up site visit by PSE staff is required for this program.

For the third-party and commercial rebate programs that are conducting post-installation site verifications as indicated above, the review team examined the verification inspection goals. Table 18 summarizes the percent of projects that each program targets.

Table 18: Third-party Programs and Commercial Rebate Program Verification Inspection Goals

Code	Program Name	Implementer	Verification Inspection Goals
E201	Low Income Weatherization	Low Income Weatherization Agency	15% of units
E214	Single Family Existing		
	Ductless Heat Pump	NEEA	5% in 2010, and 1% in 2011
	Manufactured Homes – Duct Sealing	UCONS	100% by UCONS, and 10% by ESG
	Weatherization	ECOS	10% of projects*
E217	Multi Family Existing	ECOS IQ	100% of projects
E262	Commercial Rebate (third-party)		
	Green Motor Rewind	Green Motors	Up to 20% of Motor Service Centers (MSC), at least 1 inspection per MSC per year*
	Premium HVAC Service	NEEC	10% of RTUs, 1 inspection per contractor
	Energy Smart Grocer	PECI	50% overall, and 100% of all large projects*
E262	Commercial Rebate (PSE)		
	EC Motors		100% of projects
	Hospitality		100% of projects
	Lighting Mark-Down		10% of projects
	Portable Classroom Control		100% of projects
	Variable Speed Drives		>10% of projects
	Washing Machines		10% of projects

* No information provided on how projects selected for inspection.

For the most part, the verification inspections are selected randomly. Since no information was provided, it is unclear how projects are selected for inspection for the following programs: Single Family Existing – Weatherization, Green Motor Rewind, and Energy Smart Grocer. Best practices suggest that a robust random sample of vendors and measure types be obtained.

In addition to the stated verification inspection goals and general random selection, additional inspection criteria (i.e., how projects are chosen for inspection) do vary by program:

- Single Family Weatherization: Inspects the first 10 jobs completed by new contractors, with extra inspections for contractors with high failure rates. Also, at least 10% of each contractor's jobs are inspected.
- Manufactured Homes – Duct Sealing: Includes a third-party subcontractor responsible for inspecting another 10% of projects, in addition to the third-party implementer's (UCONS) inspections.
- Premium HVAC: Conducts at least one inspection for each active contractor.
- Energy Smart Grocer: Inspects 100% of projects over $5000 (in 2010) and $7,000 (in 2011).
- Green Motor Rewind: Ensures that all Motor Service Companies are inspected and subjected to audit evaluation each year. When kWh savings reported exceeds 250,000, a second unannounced audit visit is conducted.

The verification inspection goals and strategies are found to be adequate. The programs generally obtain a random sample of sub-contractor work and across measure types (especially for the Commercial Rebate Program). The Single Family Weatherization program is notable for having a robust inspection selection criteria based on contractor historical performance (or lack thereof). Furthermore, some programs target large or uncertain projects for inspections. However, not all programs have processes to inspect projects based on risk. More programs should have verification guidelines that include inspecting the first job submitted by new vendors or sub-contractors and targeting projects that contribute larger savings.

Lastly, the review team examined the documentation of application review and inspection procedures. Although this information was requested from all programs, documentation was received only from the following programs:

- Single Family – Ductless Heat Pump: quality assurance process Flow diagram
- Single Family – Duct Sealing and Insulation: quality assurance procedures document
- Commercial Rebate -- Premium HVAC Service: excerpt from program operations manual

No documentation of application review and inspection procedures were received for the PSE-implemented Commercial Rebate Program.

Although procedures documentation was lacking, most programs were able to provide verification field forms that show what is examined during the verification inspections. Table 19 summarizes whether field forms were available for each program with verification inspection goals. There are field forms for all third-party programs with verification inspection goals. Field forms were not available, however, for several of the Commercial Rebate Program components implemented by PSE. The EC Motors program component has historically inspected 100% of projects, but no records have been kept.

Table 19: Third-party Programs and Commercial Rebate Program Field Forms

Code	Program Name[15]	Implementer	Verification Field Form?
E201	Low Income Weatherization	Low Income Weatherization Agency	Yes
E214	Single Family Existing		
	Ductless Heat Pump	NEEA	Yes
	Manufactured Homes – Duct Sealing	UCONS	Yes
	Weatherization	ECOS	Yes
E217	Multi Family Existing	ECOS IQ	Yes
E262	Commercial Rebate – 3P		
	Green Motor Rewind	Green Motors	Yes, but not provided. (Proprietary)
	Premium HVAC Service	NEEC	Yes
	Energy Smart Grocer	PECI	Yes
E262	Commercial Rebate - PSE		
	EC Motors		Unknown (None provided)
	Hospitality		Yes
	Lighting Mark-Down		Unknown (None provided)
	Portable Classroom Control		Yes
	Variable Speed Drives		Yes
	Washing Machines		Unknown (None provided)

The field forms for the third-party programs capture the necessary information for quantity and measure verification and tend to be quite detailed. In most cases, the third-party field forms collect additional operational information, such as system setpoints. Sometimes, the third-party field forms also check for customer and measure eligibility. The third-party field forms also have many questions related to quality of installation, such as proper fan venting, correct number of screws in joints, and whether or not the homeowner has an operation manual.

[15] Note that since the Commercial Rebate Program HVAC Retrofit (HE Heat Pump and AC) and PC Power Management program components do not have verification inspection goals, they were not included in this table. However, inspection field forms for these programs were submitted to the review team.

By contrast, the field forms for the PSE programs only capture the basic relevant measure information, including the following fields:

- Project information: Project name, address, meter number, project contact, contractor.
- Measure verification: Make and model #, expected quantity, verified quantity and accompanying measure-specific information (e.g., heating type, software company, number of work stations, motor make/model/horsepower, etc.)

On a few of the forms, there is a notes field, but it is unclear what types of information are expected to be recorded here. For the Portable Classroom Control, the instructions for the notes field are written as follows: "Notes (scheduling input correctly, correct product, etc...)." Since this information is actually quite important for determining whether there is a discrepancy, this information should be a required input and clearly denoted using a check box or specific input field. The PSE forms also do not collect much (if any information) related to quality of the installation.

On both the third-party and PSE verification field forms, there are some areas that are vague, such as "run the unit and assess operation" or indicate if "repaired properly." More specificity should be used in the form or some other procedures document, and documented guidance on what constitutes a pass or fail. Overall, however, the field forms capture sufficient information to determine whether there are any issues with the quantity and/or type of equipment installed compared with the rebate application and program reported savings.

3.2.2.3 Recommendations

Overall, the verification practices for the third-party and commercial rebate programs are generally consistent with best practices for verifying that actual product installations match energy efficiency program records and documentation.

A few recommendations are provided below to promote continuous improvement and program enhancement:

1. Use alternate verification methods for programs that currently do not conduct any verification.

   In some cases, it may be appropriate (and certainly more cost-effective) to use alternate methods such as phone verification or photographs to confirm measure and installation quantity for lower risk programs. In most cases, programs with low risk and low savings did not have any inspection goals. However, some amount of verification may be useful (especially for higher cost programs), since simply having a verification approach can improve the quality of projects, minimize the potential for fraud and lower evaluation risk.

2. Institute some type of verification procedure for the ENERGY STAR Clothes Washer program.

   Although the program's overall contribution to PSE energy efficiency savings is relatively small (1.1% in 2010), it is a relatively expensive program to implement and may warrant some type of verification procedures.

3. <u>Implement risk-based verification strategies at the program level.</u>

   Although, most programs perform site inspections if program staff has reason for concern, many programs lack standard processes to inspect projects based on other risk factors, such as project size or contractor experience with the program and historical inspection pass/fail rates. More programs should have verification guidelines and goals that are documented and that require inspecting the first job submitted by new vendors and targeting projects that contribute larger savings. To be consistent with new internal verification team processes recently established by PSE, random verifications should be considered on a program- and measure-level basis.

4. <u>Modify field forms to reduce judgment and subjectivity.</u>

   Rather than having inspectors determine if procedures were properly followed, the forms should list the specifications (e.g., refrigerant lines are insulated in-wall and outside and X feet from the source, rather than just "properly insulated"). If notes should be taken on whether the correct product was installed, then there should be a data entry field for this. Some of the details related to proper installation and how to assess measure operations can also be included in an inspection procedures document.

5. <u>Keep records of verification inspections.</u>

   The EC Motors program performs inspections, but no records are kept. PSE should institute a clear policy and system for keeping the results of the verification visits. The hard-copy forms should be kept in a central location and the verification findings recorded in the project file. An electronic copy should also be kept.

3.3. Evaluation planning and application

3.3.1. Methodology

To understand how PSE has planned and implemented M&V practices relevant to the 2010 program year, the review team examined both past evaluation work that informs the current 2010-11 programs, as well as current evaluation plans and activities that will affect programs in the 2012-13 program cycle. First, the team obtained relevant M&V documentation from PSE. This included a total of 18 M&V reports and plans (11 impact evaluations, 4 process evaluations, and 3 market studies), as well as overarching planning and procedural documents, such as the following:

- Energy Efficiency Services Evaluation Plan (Appendix D, dated January 1, 2010)
- Evaluation Organization Action Plan (dated February 28, 2011)
- Evaluation, Measurement & Verification (EM&V) Framework (Draft, dated March 29, 2011)
- Energy Efficiency Services Guidelines for Evaluation Study Follow-up (Version 2.0, dated June 2011)

In reviewing the evaluation overview documents listed above, it became evident that the PSE evaluation strategy is in a state of flux, with the changes directly attributable to meeting the terms of the Settlement. The Settlement (Section K.(6)(f)) calls for PSE to "perform EM&V annually on a multi-year schedule of selected programs such that, over the EM&V cycle, all major programs are covered. The EM&V function includes impact, process, market and cost test analyses."

Since the evaluation approach is changing, the team split the documents into two groups for this review based on the date of publication. Documents published before 2010 were assigned to the group of past evaluation efforts, and studies completed from 2010 and beyond are considered in the group of current studies. The team used a single approach to review the documents from both groups.

The team reviewed each report or plan and prepared a summary of major elements to place in a portfolio-wide context matrix. After examining the summaries and matrix, the team developed follow-up questions for an in-person meeting with key evaluation group staff. The purpose of this meeting was to better understand PSE's historical M&V practices, how it sets evaluation priorities, how it uses evaluation results to improve programs, and other efforts at establishing evaluation policies and frameworks. Once the team collected this information, we compared PSE evaluation practices to industry best practices. With the shift in evaluation strategy to accommodate the terms of the Settlement, the team performed the best practice review on only the set of current evaluations. Descriptions of the review steps are described below.

The team summarized its review of the 18 M&V reports and plans in Table 20 below. The matrix indicates the evaluated program year(s) and report issue date for each Residential and Business program, as well as for other market research and overall program evaluation studies. These efforts extend from the year 2005 up to present.

Details of the M&V document reviews can be found in Appendix E (the letter designations in Table 42 are cross-referenced to this table). The details consist of the following elements:

- Program(s) studied
- Program years
- Aspects addressed (gross Impact, net Impact, process, measure life, market, etc.)
- Study name
- Document title
- Evaluator (PSE or third-party)
- Report publication date
- Scope/objectives
- Research design
- Sample design
- Data collection methods
- Data analysis methods
- Recommendations
- Evaluation response report (ERR) summary
- Review comments/observations

In addition to the document reviews described above, the team was also tasked with assessing the evaluations along industry best practices. The term "Best Practice" refers to practices that result in a higher level of performance when compared to other practices that could have been used. Each of the evaluations was classified as an impact, process or market study and assessed along the appropriate best practices for that type of study.

The goal of impact evaluations is to assess the direct and indirect benefits of the program. An impact evaluation typically quantifies the extent of the changes in energy usage or demand that are attributable to the program activities. The team used the Model Energy Efficiency Program Impact Evaluation Guide from the National Action Plan for Energy Efficiency to assess the best practices of the PSE impact evaluations.

The objective of process evaluations is to assess how well the program is operating, from both the administrative and participant perspectives. The process evaluations usually cover areas such as program design, program administration, program implementation and participant response. Process evaluations often contain recommendations for changing the program processes along those dimensions to improve the efficiency, effectiveness, and/or participant satisfaction. Process evaluations can vary widely in the content addressed and methodologies employed depending on the intent of the evaluation and the type of program being evaluated. To accommodate the variation across evaluations, the team leveraged the National Energy Efficiency Best Practices Study[16] cross-cutting recommended best practices for the review of PSE's program evaluations. The National Best Practices Study provides a list of best practices developed from analysis of programs across the country. The team used this framework to assess whether the process evaluations addressed the areas, noting where there were gaps in topics covered in the evaluations across the portfolio.

Market studies can have two purposes. One is to assess how program activities have affected the overall supply chain and the market. A *market effects study* may include total market effects, an estimate of what portion of the effects are due to program activities, and an estimate of whether market changes will be sustained in the absence of the program. Another type of market study is a *potential study*, which estimates the effects of future program activities. Potential studies often include calculating technical and economic potential of the market and estimating the energy savings that could be achieved as a result of future program activities or other market interventions, such as changes to building codes or appliance standards. The estimated energy savings are usually evaluated by comparing scenarios with different underlying assumptions about program activities or other induced marked changes.

[16] National Energy Efficiency Best Practices Study, Volume S—Crosscutting Best practices and Project Summary, Quantum Consulting. December 2004. This study was managed by Pacific Gas and Electric Company under the auspices of the California Public Utility Commission in association with the California Energy Commission, San Diego Gas and Electric, Southern California Edison, and Southern California Gas Company.

Table 20: Overview of Recent EM&V Studies

		Note: Capital letters in matrix refer to specific M&V studies, as listed in Appendix E.	Program year studied (# = pending). Triangle (△)indicates year report issued.																					Claimed savings		Recently evaluated	
			2005 or prior			2006			2007			2008			2009			2010			2011						
	Schedule	Program/Sub-program	Impact	Process	Market	Impact	Process	Market	Impact	Process	Market	Impact	Process	Market	Impact	Process	Market	Impact	Process	Market	Impact	Process	Market	In 2010-2011	% of claim	Impact	Process
Residential	E150	Net Metering																									
	E200	Residential Information Services																									
	E201	Low Income Weatherization																			#	#	#	6,417	1%	1	1
	E202	Energy Education																									
	E214	Single Family existing																			#	#	#	193,327	30%		
		Showerheads							A			△												*4,389*	*0.7%*	1	
	E215	Single Family New Construction																						4,174	1%		
	E216	Single Family Fuel Conversion																						4,770	1%		
	E217	Multi Family Existing							B			B			B						△			28,942	4%		
	E218	Multi Family New Construction																						3,634	1%	1	
	E241	Community Efficiency Manager																									
	E248	Small Scale Renewables																									
	E249	Pilots: Home Energy Reports										C			C			C△						7,034	1%	1	
		Pilots, excluding Home Energy Reports																						480	0.1%	1	
		[Duct sealing & repair]																D			D △						
		[Ductless heat pumps, other pilots]																			#	#					
Business	E250	C/I Retrofit + Energy Smart Grocer	H (lighting)						△						E	F	G	E	F	G				162,214	25%	1	1
	E251	C/I New Construction	H (lighting)						△															35,230	5%	1	
	E253	Resource Conservation Manager - RCM	I	J		I	J		I	J△		I△												45,360	7%	1	
	E254	NW Energy Efficiency Alliance																						47,000	7%		
	E255	Small Business Lighting Rebate	H (lighting)						△															50,237	8%	1	
	E257	LED Traffic Signals													E	F	G	E	F	G				1,510	0.2%	1	1
	E258	Large Power User - Self Directed													E	F	G	E	F	G				9,998	1.6%	1	1
	E260	Commercial Energy Efficiency Information																									
	E261	Energy Efficient Technology Evaluation																									
	E262	Commercial Rebates																						44,098	7%		
		[Premium Service HVAC]										K	L		K△	L△								*8,203*	*1.3%*	1	1
		[PC Power Management]													M			M			△			*3,076*	*0.5%*	1	
Support	E270	Conservation Supply Curves																									
		EES Market Integration																									
		Energy Efficient Green Communities																									
		Local Infrastructure, Mkt Transformation																									
		Mainstreaming Green													N (Project Porchlight)			△									
		Market Research							O △ (CFL)		P (CFL market saturation)				△												
																	Q (VFD)	△									
		Program Evaluation																	R			R△					
		Program Support																									

3.3.2. Findings

Past evaluation efforts

Table 20 provides an overview of the impact, process, and market evaluations that PSE has completed or is currently undertaking since 2005, and how they map to the electric efficiency portfolio. Evaluations that were fully completed prior to 2010--in time to inform the design and implementation of the 2010-11 programs--included only four impact and two process evaluations of the measure groups and programs, as listed in Table 21. Up to this point, PSE has not conducted any cross-cutting evaluations across programs that address some or all the electric energy savings portfolio. Each evaluation has historically only addressed a single program or measure.

Table 21: EM&V Studies Relevant to 2010-11 Programs

Third-party review ID (from Table 20)	Program	% of portfolio savings
A (impact)	Showerheads (a part of program E214)	0.7%
H (impact)	Commercial Lighting (parts of programs E250, 251, and 254)	38.0%
I (impact), J (process)	Resource Conservation Manager (E253)	7.0%
K (impact), L (process)	Commercial Rebates – Premium HVAC Service (part of E262)	1.3%
O (impact), P (market)	Various residential and business programs with CFL measures	--

Collectively, these evaluated areas accounted for 47% of the claimed 2010-11 portfolio savings, with the bulk of that percentage consisting of commercial lighting. Another way of stating this is say that over half of the savings in the electric portfolio had not been formally evaluated in any manner in the five year period leading up to 2010. Particularly noteworthy is the residential sector, which with the exception of showerheads, had no programs evaluated during that period. Much of the claimed savings in this sector was based on RTF deemed values, but nonetheless, no formal impact studies appear to have been done to determine actual installation and retention rates. PSE did, however, help commission a pair of compact fluorescent lamp (CFL) studies that they and other regional utilities collaborated on over 2007-09, which recalculated average CFL savings and measure lives, and examined the remaining CFL market potential. These efforts led the RTF to revise their deemed CFL savings values.

The past focus has been on impact evaluations, and it is unclear what the past decision-making process has been for determining when process or market studies were needed. Ideally, these past evaluations should be informing the 2010 programs, but the paucity of studies makes that possible in only a few instances. The two process evaluations only address two particular programs, the Resource Conservation Manager and Premium HVAC Service that combined, account for less than 8% of the portfolio savings.

That said, more informal mechanisms have existed to provide feedback on the efficacy of program elements other than the evaluations. For example, many program managers make it a practice to check with trade allies, such as heating or lighting contractors, on a regular basis to assess how the market is responding to their offerings. Some commercial-sector managers have sent out postcards to obtain feedback from program participants.

Generally though, past PSE formal evaluation efforts appeared to provide incomplete coverage of their portfolio of programs, both with respect to the types of evaluations being performed and the programs studied.

Furthermore, our review of these past evaluation efforts found that the specific information provided in the studies often was lacking in a variety of ways. Common problems within reports included the lack of research plans, limited documentation, and narrowly-defined scope more suitable for answering specific research questions than assessing overall program performance.

Current evaluation efforts

Past PSE evaluation efforts were driven by informally set priorities. In recent years, the prioritization process has been formalized. For example, consultations on the topic with a consulting firm in 2008 led to the prioritization articulated in the Energy Efficiency Services Evaluation Plan for 2010-2011. The four dimensions for prioritizing evaluation of measures and projects, as described in that Plan, are as follows:

1. Pilot and new programs and measures will be given high priority for evaluation so that empirical data may be used to establish source of savings documentation and fine tune program delivery. Further, the managers of pilot and new programs and measures depend on research and evaluation to further solidify the design and impact of their measures and programs.
2. The relative contribution of each program and/or measure to overall portfolio savings is a key consideration for program evaluation. Programs and measures will be prioritized according to their relative energy savings contribution to total energy savings.
3. A two-pronged consideration of the currency of the last evaluation and the strength of that evaluation will be used to establish the priority of a measure or program being evaluated in the 2010-2011 biennium.
4. Consideration will be given to regional interests in the evaluation of programs and measures to seek opportunities to pool resources.

The Evaluation Plan also specifies that the scope of work for each program evaluation be standardized, so that the program data reviews, key considerations and performance elements, research questions, evaluation strategy, and outcomes are clearly stated for stakeholder review and approval. Evaluation research activities might include data analysis/file review, staff interviews, tailored best practice reviews, metering, billing/econometric analysis, customer surveys, trade ally surveys, and engineering analysis. The particular activities selected for a given evaluation would depend on which would best answer specific research questions and provide accurate and useful results, within the budgetary constraints.

This increase in PSE's evaluation planning rigor corresponds with increased budgetary resources. Table 22 shows actual annual expenditures for both program evaluation and research and market research activities over the past six years. What is clear is that 2010 and 2011 M&V expenditures represent a substantial increase in the level of M&V effort compared with years past. Program evaluation and research spending in particular has nearly doubled to over $1 million in 2010 and tripled to over $1.5 million in 2011, compared to its historical level of about $500,000. Formal M&V activities over the 2010-2011 biennium accounted for 1.7% of total electric portfolio costs, compared to 1.0% historically.

Table 22: EM&V Annual Expenditures

Program year	Program evaluation and research (actual $)	Market research (actual $)	Combined EM&V	Total electric portfolio costs	Program E&R as % of total	Combined EM&V as % of total
2006	See Combined M&V		$704,236	$28,695,854	n/a	2.5%
2007	$542,056	$372,364	$914,420	$36,383,430	1.5%	2.5%
2008	$451,379	$581,253	$1,032,632	$53,172,240	0.8%	1.9%
2009	$561,004	$770,464	$1,331,468	$69,617,976	0.8%	1.9%
2010	$1,026,341	$580,052	$1,606,393	$75,008,018	1.4%	2.1%
2011	$1,546,379	$591,574	$2,137,953	$77,865,547	2.0%	2.7%
2007-09 avg.	**$518,146**	**$574,694**	**$1,092,840**	**$53,057,882**	**1.0%**	**2.1%**
2010-11 avg.	**$1,286,360**	**$585,813**	**$1,872,173**	**$76,436,783**	**1.7%**	**2.4%**

PSE has also established a quality assurance (QA) group that will operate independently of the program groups. The QA group performs verification activities currently done by program staff. This QA work occurs on an ongoing basis, different from evaluations, which will occur at much less frequent intervals. Ideally, these QA activities will augment evaluations in ensuring that programs are performing as effectively as possible.

PSE has prepared a four-year evaluation plan that stipulates which programs will be evaluated over the 2012-16 period. Table 23 summarizes key elements of this plan. The intent of this, and presumably future, plans is to evaluate programs on a regular four-year cycle, thus providing some consistency and predictability to evaluation activity, and limiting the disruption to programmatic activity that evaluations can cause. In 2011, PSE began implementing this plan by hiring an M&V contractor to perform a comprehensive (impact, process, and market) evaluation of the single-family existing (Schedules E214 and G214) programs, as well as develop M&V protocols.

Additionally, PSE commissioned the firm Research Into Action to perform an evaluation organization study to assess and provide recommendations to inform decisions to strengthen existing evaluation functions. That study, as well as the ongoing Programmatic M&V study, will inform 2012-13 evaluation efforts. PSE adopted a new evaluation framework in fall of 2011.

PSE's past evaluation focus has been on impact evaluations, but their intent moving forward is to perform more comprehensive evaluations that will simultaneously include process and market elements, as well as impact studies. This latter approach is consistent with recent CRAG and UTC suggestions.

Table 23: Estimated Four-Year Cycle Evaluation Plan

Programs	2012	2013	2014	2015
E250/G205, E258, E257: C&I Retrofit, Self Directed & Traffic Lights				x
E201/G203: Low Income	x			
E251/G251: Commercial New Construction	x			
E214/G214: Single Family Existing	x			
E217/G217: MF Existing				x
E215/G215: SF New Construction		x		
E218/G218: Multifamily New Construction		x		
E262/G262: C&I Rebates		x		
E253/G208: Resource Conservation Manager			x	
E216: Gas Conversion			x	
E249: Pilots	x	x	x	x
Other Projects	x	x	x	x

PSE is also improving the process by which the results of evaluations inform future programs. In 2010, they instituted the Evaluation Response Report (ERR) process. As documented in the Guidelines for Evaluation Study Follow-up, after an evaluation is completed, affected program managers prepare an Evaluation Response Report that clearly states how the programs will change in response to evaluation findings. The impetus for the process was to facilitate communication between evaluation and program groups. While such interaction occurred informally in the past, the ERR process helps better ensure that program staff thoroughly understand the evaluation process, and buy into the evaluation recommendations. ERRs also help build the institutional memory of evaluation practices and results. The ERR process is now functioning smoothly, according to evaluation staff. At this time, there is no formal mechanism to check back after the ERR is issued to confirm that the recommendations were successfully implemented. PSE's current expectation is that program managers will hold their staff accountable for doing so.

Comparison with best practices

Currently, PSE does not have internal evaluation guidelines for establishing the scope, budget, methodology for studies. They informally look towards the International Energy Program Evaluation Conference (IEPEC) proceedings and materials, as well as the California Evaluation Framework and Protocols for some guidance. PSE's goal is to develop internal guidelines specific to PSE programs by the end of 2012. Past evaluation planning relied on unwritten understandings and intuitive considerations.

As the funding for evaluation activity has increased in recent years, the focus has changed, and the need to formalize processes has become more apparent.

PSE began implementing changes to their evaluation strategy and has developed plans and processes to support the formalization of the evaluations of their energy efficiency programs. The Evaluation Organization Action Plan, the EM&V Framework and the Guidelines for Evaluation Study Follow-up have been developed to facilitate the change in evaluation strategy. Although the framework has not been finalized at the time of this report, the team assessed the evaluation strategy for the portfolio of programs as documented in the Action Plan according to Crosscutting Best Practices for Program Evaluation identified in the Best Practices Study. These ten best practices (stated first in bold), and our assessment of how PSE's current evaluation practices compare, are listed below:

1. **Engage the implementation team in the evaluation process.** The PSE Evaluation Organization Action Plan identifies a process to engage the implementation team from the early stages through the end of the evaluation. The process calls for implementation staff to participate in pre-chartering meetings, chartering meetings, check-ins and the presentation of preliminary findings and wrap-up. It is our understanding that progress has been made in engaging implementation staff in evaluation activities.
2. **Create a culture in which evaluation findings are valued and integrated into program management.** The Energy Efficiency Services' Guidelines for Evaluation Study Follow-up presents a plan for reviewing evaluation reports and establishes policies for reviewing and developing action items in response to recommendations from the evaluations. Although policies have been adopted to develop action items in response to evaluation results, it is our understanding that PSE does not formally confirm that the action items have been executed.
3. **Present actionable findings to program staff both in real time and at the end of study.** The PSE Action Plan describes the opportunity for interim results to be delivered to implementation staff, and provides guidance as to how to identify when interim results may be most useful.
4. **Stagger the timing of process and ex post impact tasks so that process evaluations can be conducted and results communicated on a relatively real-time basis.** The Action Plan recommends process evaluations take place six to twelve months after a program is launched, and then every few years once a program is established. It is our understanding that the process evaluations for established programs are scheduled to coincide with the timing of the impact study for a program, which may lead to findings that are outdated or no longer relevant to the program. However, the implementation of the Evaluation Response Report requirement can help to facilitate developing action items on a timely basis.
5. **Conduct detailed ex post, impact evaluations routinely, though not necessarily annually.** The Action Plan recommends scheduling evaluations on a four-year cycle. The EM&V Draft Framework prioritizes impact evaluations over process evaluations and reiterates the proposed evaluations for all major programs on a four-year cycle.

6. **Include periodic estimation or free-ridership and spillover.** The EM&V Draft Framework states that PSE will examine program spillover and free ridership when it is feasible to do so, for program design purposes. The Framework describes several approaches that may be used to determine free-ridership and spillover.
7. **Use regular process evaluation activities to provide timely and fresh data.** The Action Plan recommends that process evaluations be conducted every few years. The Draft Framework describes the general method of prioritization of evaluations, with the more detailed prioritization presented in the annual Evaluation Plan. It is our understanding that the implementation of process evaluations will be at the discretion of the budget and prioritization process.
8. **Periodically review & update market level information about construction practices, market share and measure adoption.** The Draft Framework discusses market effects studies within the evaluation cycle, and identifies market characterization and market transformation attributes for measure and programs as other metrics that may be requested by the WUTC as part of evaluations.
9. **Perform market assessments for those programs that have a market transformation (MT) component.** The Action Plan recommends that one market assessment is conducted for each sector. It is our understanding that the implementation of market studies will be subject to the budget and prioritization processes as described in the annual Evaluation Plan.
10. **Support program review & assessment at the most comprehensive level possible.** The Estimated Four Year Cycle Evaluation Plan indicates the schedule for when each program will undergo some type of evaluation, but it does not indicate the type of evaluation the program will undergo in the cycle. It is our understanding that the priority is for impact evaluations to be conducted.

The overall evaluation strategy of PSE appears to be much more comprehensive in scope and if implemented as planned, demonstrates progress towards best practices for evaluation across the portfolio.

The evaluation reports, plans and proposals shown in Table 24 were considered part of the current evaluation plan and were reviewed in more detail against best practices:

Table 24: Current Evaluations

Third-party review ID (from Table 20)	Program
B (impact)	Multi-Family Existing (E217)
C (impact)	Pilots/Home Energy Reports (part of program E249)
D (impact and process)	Pilots/Prescriptive Duct Sealing and Repair Pilot (part of program E249)
E(impact), F (process), G (market)	C&I Impact (parts of programs E250, E257 and E258)

Third-party review ID (from Table 20)	Program
M (impact),	Commercial Rebates – PC Power Management (part of E262)
N (impact)	Project Porchlight (part of E270)

Although the overall PSE evaluation strategy aims to include process evaluations, only one process evaluation, which covers three commercial/industrial programs, was planned for the 2009-2010 program years. Another study, which was planned as only an impact study, was expanded to include a process evaluation component to address specific issues that were discovered during the initial phase of the impact evaluation. The absence of planned systematic process evaluations may lead to missed opportunities for updating, streamlining and generally improving program implementation procedures and may result in higher expenditures or lower savings achievements.

As shown in Table 25, the activities described in the work plan for one evaluation were reviewed and found to cover many elements of process evaluations, as outlined by the National Action Plan for Energy Efficiency. Not surprisingly, the other report that investigated specific process issues of a program was reviewed and found to have included only a few of the elements of a process evaluation.

Table 25: Review of Process Evaluation Elements

	Third-party review ID (from Table 24)	
Elements of Process Evaluation	Report "F"	Report "D"
Process Evaluation		
1. Program Design	Planned	
1.1 The program mission		
1.2 Assessment of program logic	Planned	
1.3 Use of new practices or best practices	Planned	
2. Program Administration		
2.1 Program oversight		
2.2 Program staffing		
2.3 Management and staff training		
2.4 Program information and reporting	Planned	Included
3. Program Implementation		
3.1 Quality control	Planned	Included
3.2 Operation practice -- how program is implemented	Planned	Included
3.3 Program targeting, marketing and outreach efforts	Planned	
3.4 Program timing		
4. Participant Response		
4.1 Participant interaction and satisfaction	Planned	
4.2 Market and government allies interaction and satisfaction	Planned	Included

	Third-party review ID (from Table 24)	
Elements of Process Evaluation	Report "F"	Report "D"
5. Overall Assessment		
5.1 External or internal evaluators	External	External
5.2 Number of data collection methods	7	2

The current impact evaluation reports were assessed for best practices along the components described in the Model Energy Efficiency Program Impact Evaluation Guide from the National Action Plan for Energy Efficiency. The results of these assessments are shown in Table 26. In general, the current impact evaluations appear to cover the components essential for an impact study. Two areas are discussed in reports less frequently –persistence and the net savings. Persistence can be difficult to assess, and may be out of scope for the evaluations. Net savings is not expected to be covered in PSE evaluations because of the method of determining cost effectiveness of the programs. Further review could provide an assessment of the validity of the results from the evaluations.

Table 26: Review of Impact Evaluation Components

Component		Third-party review ID (from Table 24)					
		B	**N**	**C**	**E**	**M**	**D**
Overall Assessment							
Evaluators	Ex –External In – Internal	Ex	Ex	Ex	Ex	Ex	Ex
Status	P - Proposal E - Evaluation Plan C – Completed	C	C	C	E	C	C
Portfolio vs. program	S– Single program M– Multiple programs, but not portfolio P– Portfolio	S	S	S	M	S	S
Persistence	E – EULs from other sources P – Primary data collection NP – Not provided. Insufficient documentation to score this criterion	NP	P	NP	E in Plan	NP	NP
Documentation within evaluation	1 – Insufficient documentation provided 2 – Partial documentation provided 3 – Documentation appears sufficient	3	3	3	2 in Plan	3	3
Recommendations	1 – Report does not include recommendations for program improvements. 2 – Report provides some recommendations, but appears incomplete based on analysis completed. 3 – Report provides relatively comprehensive set of recommendations	3	3	3 - Ltd in scope	NA	3	3

Component		Third-party review ID (from Table 24)					
Gross Savings							
Verification	1 – Paper verification. 2 – Phone or mail verification. 3 – Physical (on-site) verification. NP – Not provided. Insufficient documentation to score this criterion	NP	2	NA	3	3	1
M&V Approach - IPMVP Options		Yes	NA	NA	Yes	Yes	Yes
Deemed Savings Approach		Review	Yes	NA	Review	NA	NA
Large-Scale Data Analysis Approach		NA	NA	Yes	NA	NA	Yes
Baseline	Proj – Project-Specific baseline. Perf – Performance Standard baseline. NP – Not provided. Insufficient documentation to score this criterion	Proj	NP	NA	NP in Plan	Proj	Proj
Sampling	1 – Sampling mentioned, but no description provided. 2 – Sampling partially described. 3 – Sampling approach fully described, or census. NP – Not provided. Insufficient documentation to score this criterion.	3	3	3	3	3	3
Precision	1 – No sampling precision reported or discussed. 2 –Sampling precision was discussed in some manner but not completely. 3 – Target and achieved precision (or error bounds) were reported. NP – Not provided. Insufficient documentation to score this criterion.	2	3	3	3	2	3
Net Savings							
Approach	SRS – Self-reporting surveys ESRS - Enhanced self-reporting surveys EM- Econometric methods NTGR - Stipulated net-to-gross ratios NP – Not provided. Insufficient documentation to score this criterion	NP	NP	NP	NP	SRS	NP
Free-ridership	PFR-Partial Free ridership addressed FR - Free ridership addressed, but not Partial free ridership NA - None included	NA	NA	NA	NA	PFR	NA
Spillover effects	PS-Participant NPS - Non-Participant NA - None included	NA	PS	NA	NA	PS	NA

Summary of M&V Practice Findings

The review team investigated PSE's past, current, and future evaluation efforts and plans, engaged in in-depth discussions with PSE evaluation staff, and compared PSE evaluation activities with industry best practices. The team found that past evaluations, which should be informing the 2010 programs, only covered a small portion of the overall electric portfolio. Process and market evaluations in particular were rare. Common problems with the studies included lack of research plans, limited documentation, and narrowly-defined scope more suitable for answering specific research questions than assessing overall program performance.

In the last couple of years, however, PSE has ramped up the breadth and rigor of their M&V efforts substantially. Evidence of this includes developing M&V action plans and frameworks, establishing an evaluation response report system to help complete the evaluation loop, and commissioning more comprehensive evaluations of major program areas (such as commercial/industrial retrofit, and single-family existing programs), and expanding the scope of the process and impact evaluations. Evaluation budgets have risen significantly as well, consistent with the increased activity.

PSE has significantly formalized their planned EM&V activities over the next few years. These changes, as currently laid out, will move PSE closer to industry best practices. Because of the dramatic shift that future activities represent, however, it will be important to carefully monitor and ensure that these activities are carried out in accordance with the guiding internal action plan, framework, and guidelines.

4. Cost-effectiveness Calculation Review

The objective of this review was to examine the methodology, inputs, and calculations used to determine portfolio and program cost-effectiveness, and assess whether they were consistent with the terms of the settlement. This section describes how we carried out this review, and presents the corresponding findings. The review team conducted the review for the 2010 and 2011 program years. For the 2011 review, the team addresses the changes from 2010, what were they, and whether they are consistent with the terms of the settlement.

4.1. Methodology

The settlement establishes that the primary cost-effectiveness test that PSE should apply is the Total Resource Cost (TRC) test, using a methodology consistent with the Northwest Pacific Power and Conservation Council (the Council) approach. The settlement also stipulates that overall cost-effectiveness should be evaluated at the portfolio level, and that cost-effectiveness should also be assessed using Utility Cost (UC), Ratepayer Impact Measure (RIM), and Participant Cost (PC) tests. The relevant sections of the settlement are provided in the appendix (refer to Sections K.(7)(d) and K.(10)(a) through (c)). [17]

In addition, PSE analysis must include quantifiable non-energy benefits, the 10 percent conservation benefit, and a risk adder consistent with the Council approach.[18] Collectively, these conditions comprise the standards that PSE must use in its reporting for its programs and portfolio's cost-effectiveness. This section discusses PSE's calculation approach, compares it to the Council approach, performs due diligence of calculations, and discusses if PSE is in compliance with the above-stated conditions.

The team reviewed PSE's cost-effectiveness calculations that are reported in Appendix D for its 2010 and Exhibit 2 for its 2011 annual conservation report. The team documented the following elements to confirm if PSE is in compliance with the prior (above) settlement agreement.

[17] PSE is not required to submit Participant Cost Test (PCT) and Ratepayer Impact Measure (RIM) test results until the 2012-2013 program cycle. As a result, these two tests are not discussed here.

[18] The Council's approach includes the following elements: (1) Avoided energy and capacity cost of future wholesale market purchases (forward price curves) that takes into account the shape of savings (impact load shapes), and uncertainties in future market prices, (2) Cost inputs including the full incremental measure cost, any applicable ongoing or periodic O&M expenses, and utility administrative costs, (3) Benefit inputs including direct energy and capacity savings, avoided T&D losses, deferral of T&D expansion (if applicable), non-energy benefits (e.g., water savings), and environmental externalities¸ and (4) Discounted present value based on an after-tax average cost of capital weighted for project participants. Details can be found at: http://www.nwcouncil.org/energy/powerplan/6/supplycurves/I937/CouncilMethodology_outline%20_2_.pdf.

1. Correct methodology, if necessary, to be consistent with National Action Plan for Energy Efficiency (NAPEE) and industry practices for calculating RIM, PCT, TRC, and UC:
   - Document equations
   - Confirm consistent with NAPEE[19]
2. Confirm consistent with the Council
   - Run PSE program data in the ProCost tool to calculate TRC using the Council load shapes, avoided costs, and other inputs
3. Conduct due diligence review of calculations:
   - Did PSE properly summarize the individual programs in calculation sheets?
   - Was proper load shape used?
   - Was proper program measure life used?
4. Assess validity of calculation inputs, including:
   - Avoided costs
   - Administrative costs
   - Incremental measure costs
   - Discount rate
5. Ensure compliance with settlement agreement:
   - Review PSE's interpretation of calculations and ensure all elements are in compliance with the settlement agreement

As the team concluded this review, the results from the Washington State Conservation Work Group (WSCWG) published under docket number UE-110001[20] were released to the team (early June 2011) The WSCWG examined if the IOUs methodologies to determine avoided costs and to calculate TRC were consistent with the Northwest Pacific Power and Conservation Council (Council). Our team compared the independent avoided-cost review we performed to the Council's 6th plan in Section 5. Here, the team discusses our observations in light of WSCWG's results.

[19] NAPEE 's document "Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers", November 2008, refers to the California "Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects" as the source of the principal approaches used for evaluating energy efficiency programs across the Unites States.

[20] http://www.utc.wa.gov/docs/Pages/DocketLookup.aspx?FilingID=WSCWG

Calculating Cost-Effectiveness—Definitions and Methodology

In this section, we discuss the two tests currently required under the settlement agreement and as interpreted by NAPEE. Currently, PSE reports the PAC (or UC) and TRC tests. The methodologies used by PSE were consistent with the guidelines established by NAPEE. Any deviations by PSE are discussed here.

The basic approach to calculating cost-effectiveness is on a net present value (NPV) basis. The test results are typically reported as net benefits in dollars (NPV of the sum of the benefits minus the NPV of the sum of the costs) or as a benefit to cost ratio (NPV of the sum of the benefits divided by the NPV of the sum of the costs). NAPEE does not extend the discussion further in its document on the details of the calculations. The approach in 2010 was to levelize all costs, whereas, the 2011 approach was to use the cumulative NPV of costs.

Program Administrator Cost or Utility Cost Test (PAC or UC). This test compares the program costs to the effect of the program/measures to reduce supply side resource costs. The program costs to implement energy efficiency measures includes direct installation costs incurred by the utility (as opposed to the participant), conservation acquisition payments (through rebates or incentives[21]), administration, overhead, evaluation, and marketing expenses. These costs combined make up the program administrator costs. Benefits included in this cost test are the utility's avoided energy and capacity costs including transmission and distribution. This test does not consider the effect on utility revenues and the customer retail rates.

PSE's methodology is consistent with NAPEE's approach where the avoided energy and capacity costs are captured as benefits and program overhead, program incentives, and program administrator installation costs are the costs. The 2010 PSE calculation for the present value of the costs is as follows:

$$PVTC\_UC = \frac{TC_{1\_UC}}{IMP_1} * LFCR$$

Where,

$$LFCR = \left[\frac{d}{1-(1+d)^{-n}}\right]$$

PVTC_UC = Present Value of the total program administrator costs (includes incentives)

TC_{1_UC} = Total program administrator costs (including incentives) in year one since all costs are incurred in the first year to acquire the energy savings.

IMP_1 = Savings impacts in kWh for the first year.

d = Nominal discount rate. PSE uses 8.25% for all calculations.

n = Measure life, in years

[21] The discussion in this report will use the term incentives to refer to conservation acquisition payment.

In 2010, PSE levelized the costs using a multiplier called the levelized fixed charge rate (LFCR) to discount the total costs of the program. This approach assumes the kWh savings realized in the first year of the program will be uniform throughout the life of the measure.

Levelized cost is often cited as a convenient and comparable summary measure of the overall competiveness of different resources including DSM programs. Levelized cost represents the present value of the total cost of a program or measure(s) over the life of the measure(s) or program (ideally, the weighted average life of all measures in the program) and converted to equal annual payments. While all of the costs calculated in the UC and TRC tests are incurred in year one, levelized cost can be used to express all variable costs over the life of a measure.[22] As referred to above, NAPEE only refers to comparing the NPV of the benefits and costs; PSE just takes this one further step by levelizing, but both provide the same results.

The benefit-cost (B/C) ratio is calculated as follows:

$$B/C = \frac{PVIMP}{PVTC}$$

Where,

$PVIMP_{2010}$= Present value of total avoided energy and capacity costs. The values used by PSE are based on the measure life by end use from the “ElecCEStd2010-2011 wo ConsCred” worksheet (for the UC test). PSE values are all levelized avoided costs.

$PVIMP_{2011}$ = Present value of total avoided energy and capacity costs. The values used by PSE are based on the measure life by end use from the “CE Std 10-11_Electric_w 10% cons credit_Bobbi_NPVOFAvoidedCosts.xlsx” worksheet (for the TRC test). PSE avoided cost values are all sum of the stream of avoided costs adjusted to year zero[23].

$PVTC\_UC_{2011}$ = Present Value of the total program administrator costs (includes incentives). To calculate for year zero, costs are discount by dividing by (1+d) where d is the discount rate of 8.25%

Total Resource Cost Test (TRC). This test considers the cost and benefits of an efficiency measure as a resource option based on its total cost, including both the participant and the utility. Participant costs include the cost to purchase a measure, install it, and maintain the more efficient equipment (total measure costs)[24]. The incentives are used to offset measure costs. Utility costs include marketing, program administration, evaluation, and any direct installation costs incurred by the utility. Incentives

[22] http://www.eia.doe.gov/oiaf/aeo/electricity_generation.html

[23] This analysis can be found in “Final Report: Calculating the Cost-Effectiveness of Puget Sound Energy’s Energy Efficiency Programs” and its related appendices.

[24] In some cases, the incremental measure cost is used instead.

are not included in TRC calculations as they are not an additional resource cost (the costs covered by this value are already included as part of the participant or utility costs).

Most of the inputs to PSE's 2010 TRC worksheet are directly referenced from the UC worksheet with differences to the inputs for levelized costs and benefits.

Though NAPEE discusses and the Council's TRC test requires the inclusion of quantifiable Non-Energy Benefits (such as environmental or additional resources saved), they are not quantified by PSE, since all programs have a B/C ratio greater than 1.0 without the additional value of Non-Energy Benefits.[25] The PSE cost-effectiveness standard value per kWh is taken from the sheet "ElecCEStd2010-2011 w ConsCred" for 2010 and CE Std 10-11_Electric_w 10% cons credit_Bobbi_NPVOFAvoidedCosts.xlsx" for 2011, which includes the agreed-upon 10% Conservation Credit discounted values per the settlement agreement.

For this test, total program administrator costs (not including incentives) are calculated from the following parameters:

TC_{1_TRC} = Total program administrator costs (not including incentives) + Total measure costs

Total measure cost = incentives + Total costs to the consumers

The methodology for the benefit-to-cost ratio is discussed in the prior section under "utility cost test." The same ratio calculation is used here.

4.2. Findings

Significant changes PSE made to the calculations between the two years include:

- More clear and transparent calculations.
- Instead of levelized avoided costs, using net present value of the stream of costs.
- Measure level assignment of measure life and load shape instead of program level.

Making these above changes is impressive when the PSE program tracking data are not in one system. Many of the cost-effectiveness calculations and steps are completed manually. These manual steps include setting up the program level data and assigning load shapes on a measure level. PSE has taken steps to continuously improve the tracking systems and cost-effectiveness analysis. These improvements should be seen in subsequent program and portfolio level reports.

[25] PSE's TRC test also includes a provision for acknowledgement of Un-quantified Non-Energy Benefits as a condition for passing the TRC test as long as the B/C ratio is equal to or greater than 0.66.

4.2.1. Comparison of PSE and the Council Cost-Effectiveness Calculations

In all the inputs discussed earlier, the two entities, PSE and the Council, use different values and assumptions but similar methodologies. The WSCWG looked at the several parameters, and a summary of their comparisons is shown in Table 27. Details of the calculation inputs, per the third-party review, are provided in this section.

The following table summarizes WSCWG's observations on PSE for 2010 and 2011 and the Council's TRC methodology. The third-party review team made the same conclusions as WSCWG that PSE is generally consistent with the Council. Similar to the differences with NAPEE, PSE's approach calculates the levelized costs and benefits, and the Council only calculates the net present value of the costs and benefits. However, for the 2011 program year calculations, the analysis uses the same approach as NAPEE and the Council. The inputs to PSE calculations did not change between the two program years for avoided energy costs, load shapes, benefit inputs, and discount rates.

Table 27: WSCWG TRC Methodology Comparison

	Council	PSE	Consistency with Council Method
Benefits			
Avoided Energy & Capacity Benefits			
Direct avoided energy/capacity savings	Based on Aurora forecast of 8,760 market prices aggregated into 4 time segments per month (48 annual segments) for cost-benefits analysis, wide ranges and volatility added for portfolio analysis to capture risk. Values are established for resource types that align with measure types. where an 8,760 hourly load shape is available.	AC Energy = Base case market price forecast + line loss adjustment + risk factor (called the "Planning Adjustment") + 10% Power Act credit AC City = Base case avoided capacity cost + deferred T&D expansion costs + reserve margin adjustment + 10% Power Act credit	In program analyses outside the IRP, PSE calculates separate avoided cost streams for energy and capacity and brings them together in its TRC calculation.
Avoided T&D line losses	3.9% WECC transmission losses and 5% distribution losses, average about 9% total. Transmission losses vary by load levels, so losses differ by load profile of measures.	Determined from cost-of-service energy allocation calculations. Program analysis separates system average into residential and C/I class averages.	PSE utilizes average system losses; Council assumes marginal losses.
Deferred T&D system savings	For distribution only. Based on kW avoided at coincident peak and $ value of deferred kW expansion.	Based on projected budget for capacity-related expansion of PSE-owned transmission & distribution. Applied to avoided peak capacity.	PSE, like the Council, include a T&D deferral credit. Values may vary based on PSE system characteristics.
Quantified Non-Energy Benefits			

	Council	PSE	Consistency with Council Method
Non-energy benefits (water, etc.)	For quantifiable benefits or costs such as water, detergent, and internal end-use heating and cooling interactions.	None for current program analysis, because programs have been cost-effective without them, and they can be difficult to quantify. There is a placeholder in PSE's cost-effectiveness model to include them.[26]	PSE can now include NEBs, consistent with the Council. Assumed values may vary.
Environmental externalities	Emissions are tracked and will be reduced through lower dispatch of generation. Includes cost of required control technologies. Include a range of potential CO2 costs from $0 to $100, growing over time averaging $47 by 2030.	Emission costs included in AURORA forecast of market prices. Costs include required control technologies plus a range of carbon costs across planning scenarios.	All parties handle this similarly. Assumptions about values vary.
10% Power Act credit	Applied to energy & deferred capacity components of value only.	Applied to Energy and Capacity values for calculation of TRC.	Apply the 10% credit, but not as a direct adjustment to avoided cost in all cases. PSE is consistent with the Council.
Un-quantified Non-Energy Benefits (if/how included)	Not directly, but may be partly reflected in 10% Act credit; otherwise a portfolio judgment by Council. Typically not influential in decision, mostly based on quantifiable costs and benefits.	In limited cases. May be considered if a program is not otherwise cost effective if B/C ratio is at least .67 (has been applied only to low-income weatherization).	PSE has used this as a "nudge" to its low-income program in past years, but it has not been necessary recently.
Costs			
Full incremental measure cost (material & labor)	Full incremental cost over current practice or codes and standards.	Yes, full incremental cost over current practice or codes and standards.	All parties treat measure costs consistently. Assumptions about values may vary, depending on local market costs.
Ongoing and periodic O&M costs (plus or minus)	To extend a measure life if less than 20-year planning horizon. Replacement costs are included.	No because impact is small and would not materially affect cost-effectiveness. Any cost reductions (i.e., negative costs) would be treated as non-energy benefits.	PSE includes O&M costs where data is available and where TRC results would be materially affected. Assumed values may vary.
Non-incentive Program Costs (planning, marketing, delivery, admin, evaluation, etc.)	Generally assume administrative costs are 20% of capital cost of measures.	Program analysis uses all costs as actually budgeted or spent, depending on perspective of the analysis.	PSE includes non-incentive costs, consistent with the Council. For non-IRP program analyses, specific program budgets or actual expenditures are used.
Present Value Calculation Inputs			
Discount rate (real or nominal, pre-tax or post-tax, etc.)	Real rate after tax cost of capital. Rates vary for different types of utilities and consumers and debt versus equity.	Yes. Uses nominal PSE-weighted average over long-run cost of capital.	All utilities use their weighted average cost of capital, while the Council uses a hybrid of utility cost of capital and customer long-term discount rate.
Time frame (program/measure life, other term)	Twenty-year program analysis. Measure lives <20 years are re-purchased, longer are prorated and truncated.	Individual measure lives are assigned up to a 30-year maximum. Program analysis is based on one life cycle of a measure up to 30 years.	For non-IRP program analysis, PSE uses one measure lifecycle as the time frame.

[26] Plans to include for 2012-2013 program cycle.

	Council	PSE	Consistency with Council Method
Results Presented			
B/C Ratio	Present value benefit-cost ratio for measure screening	For program analysis	All calculate B/C ratios.
Levelized values	For portfolio analysis.	For program analysis	Calculated by all parties.
Total NPV values	For parts of analysis and results presentation. Levelized and NPV are functionally equivalent.	Not for program analysis.	PSE calculates NPV values, but NPV is not generally reported for non-IRP program analyses.

Avoided Energy Costs

The embedded avoided energy costs and impact load shapes are different between PSE and the Council. These avoided energy costs are explained in more detail under the review of avoided energy costs discussed in Section 5 and are summarized in the WSCWG matrix. The team investigated the Council's embedded ProCost macros to a limited degree. Unfortunately, ProCost is not fully documented yet to perform a detailed review. However, in review of MC_AND_LOADSHAPE_6P.xls used in conjunction with ProCost (ProCostRTFTemplate257e_v3_1.xls), the Council ProCost tool calculates cost effectiveness using 207 different load shapes (user selected by measure) that are disaggregated into monthly and four time segments for each month values (see "load shape map" tab in MC_AND_LOADSHAPE_6P.xls). PSE does a weighted average based on the hourly load shape profiles and costs to determine one annual avoided cost value.

Load Shapes

Load shapes help select the avoided costs used in cost-effectiveness analysis. A report prepared by KEMA for Northwest Power and Conservation Council and Northeast Energy Efficiency Partnerships, "End-Use Load Data Update Project Final Report" in 2009 identifies that there is a big gap in updated and regional data for end use load shapes. Since it was identified that both groups rely on different data sets, it generated additional concerns on the proper development, source, and application of load shapes.

The sources of the actual impact load shapes for the Council (documented in the tab called "Load and coincident factors") and for PSE are different. PSE's determination of the yearly average avoided costs is discussed below. The source of the impact load shapes seem to be different since the calculated load factor[27] are not the same yet both entities use the same definition (PSE values can be found in 2010_8760.xls). The Council's load shapes are mostly from ELCAP (End-use Load and Consumer Assessment Program[28]). PSE is using load shapes developed by the Cadmus Group for PSE's

[27] As defined in MC_AND_LOADSHAPE_6P.xls, load factor (or LF) is the ratio of average energy for the year (annual kWh/8760) to peak demand. Load factors are computed for each time period. Load factors can be greater than 1.0 when the coincident demand for the time period is lower than the average yearly demand. In other words, the LF is the annual average hourly savings (or average load shape) divided by peak kW savings (peak load shape).

[28] ELCAP was based on data gathered through the mid 1990s.

conservation potential assessment used in the 2009 IRP. These load shapes were developed through a combination of building simulation modeling and secondary sources. The load shapes used in PSE's 2010-11 cost-effectiveness model are a subset of those used in the IRP. The IRP uses load shapes for each combination of end use and building type. PSE performed a comparison of load shapes and found that many end use shapes did not vary significantly by building type. In these cases, PSE selected end use load shapes that were considered most representative of the type of customer participating in energy efficiency program to minimize the size and complexity of the cost-effectiveness model.

The following is a table compares the two values. Since the end use (i.e., load shape) naming convention is different between the Council and PSE, the table maps the two with the end use described.

Table 28: Mapping of End-Use Load Shape – Load Factor Values

PSE C-E End Use	PSE	PSE Assumption	Council	Council End Use Description	Council Code
SF Space Heat	0.1553	SF Central Heat	0.21	Residential Space Heating - Retrofit Regional Average	ResSHWX
Residential Water Heat	0.5809	SF	0.29	Residential Domestic Water Heating	ResDHW
SF Residential Lighting	0.4739	SF	0.4	Residential Lighting	ResLIGHT
SF Heat Pump	0.1513	SF	0.16	Residential Space Heating - Heat Pump Heating Zone 1	ResSpHtHPZ1
Residential Plug Load	0.5336	SF	0.45	Residential Other	ResOTHER
MF Space Heating	0.2038	MF Central Heat	0.21	Residential Space Heating - Retrofit Regional Average	ResSHWX
MF Lighting	0.4755	MF	0.4	Residential Lighting	ResLIGHT
MF Heat Pump	0.2126	MF	0.16	Residential Space Heating - Heat Pump Heating Zone 1	ResSpHtHPZ1
Commercial Cooking	0.5764	Restaurant	0.67	Commercial Lighting - Existing Restaurant, Unspecified Heating Fuel	ExRest
Commercial Cooling	0.1094	Office Chillers	0.48	Commercial - Existing Shell & HVAC Measures	ExComm
Commercial Heating	0.0862	Office	0.48	Commercial - Existing Shell & HVAC Measures	ExComm
Commercial Lighting	0.4795	Office	0.57	Average of Commercial Lighting - Existing	
Commercial Refrigeration	0.6162	Grocery	0.52	Average of Commercial Grocery Refrigeration	
Flat	NA	NA	1	Other - Flat Load Profile	FLAT

Cost Inputs

There are three sources of cost inputs:

- Administrative (which may include incentives)
- Measure costs
- Operations and maintenance costs

Under administrative costs, the Council includes:

- Program planning
- Marketing
- Delivery
- On-going administration
- Evaluation

PSE considers all costs attributable to a program, except incentives, to be administrative costs. This would include all marketing costs, labor, materials, office supplies, and outside services that it takes to run a given program. Program costs are tracked by order numbers in PSE's internal accounting system.

The actual percent administration cost allocations by program are summarized in the following table. The table compares the two program years. It is expected that costs vary by program type and delivery channels. The ProCost default is 20%. In general for most programs, there is not much variation between the program years, which is expected and hence PSE is tracking consistently.

Table 29: Actual Programs Costs as a Percentage of Measure Costs

Program Name	2010	2011
Low Income	11%	6%
Single-Family Existing	24%	19%
Single-Family New Construction	54%	69%
Single-Family Fuel Conversion	5%	7%
Multi-Family Existing	18%	18%
Multi-Family New Construction	12%	33%
Total Residential Efficiency Programs	22%	23%
C/I Retrofit	8%	11%
C/I New Construction	4%	1%
Resource Conservation Manager - RCM	46%	40%
Small Business Lighting Rebate	7%	7%
LED Traffic Signals	1%	0%
Large Power User - Self Directed	5%	2%
Commercial Rebates	9%	9%
Total Business Efficiency Programs	9%	9%
Total Portfolio	14%	23%

Incremental measure costs for PSE and the Council seem to be based on measure cost studies. For comparison purposes, the team used PSE's measure costs from its tracking system to calculate TRC. NAPEE provides guidance on defining costs and impacts. The definitions are in line with the Summit Blue study conducted for PSE in 2008, "Best Practices for Assessing Measure Costs." However, NAPEE recommends that in some cases retrofit measures (early replacement) the measure cost is the cost of the efficiency device minus the cost of the standard device plus remaining present value which is not included in the Summit Blue report[29]. The team did not review if the guidelines were followed within the program tracking system project documentation. For this study, the team did not complete a detailed review of this comparison of the measure costs. More information about incremental measure costs used by PSE is provided later in this section.

The Council also includes ongoing costs and periodic operations and maintenance costs, if applicable. These costs are not captured in PSE's analysis.

Benefit Inputs

The only benefits tracked by PSE are energy savings, which are discussed in detail in the following avoided cost section. No demand savings are tracked or accounted for in the cost-effective analysis but capacity avoided costs are rolled into the energy savings' avoided costs. The energy savings are translated into avoided costs. These costs include transmission and distribution losses. The Council also includes non-energy benefits and un-quantified non-energy benefits as inputs. Both PSE and Council methodologies assumed a 10% regional act conversation credit percentage. This percentage is incorporated into PSE's analysis only in the TRC calculation and not in the UC calculation.

Discount Rates

The weighted average (or actual) after tax cost of capital by sector per the Council is dependent on the sector and perspective of the stakeholder's view.

The ProCost calculator defaults to one of the pre-determined values depending on the defined sector/stakeholder for the after tax cost of capital, similar to NAPEE. However, both the TRC and UC are only based on the utility perspective. The WSCWG states the nominal discount rate is 8% in the sample TRC calculations. The review team's examination of RTF deemed measure workbooks show 5%, as the real discount rate. PSE uses a nominal rate of 8.25% for all discounting and 2.5% for the inflation rate[30]. Per the Council, regional IOUs in recent integrated resource plans ranged between about 7.0 - 8.3 percent in nominal terms, or 5.1 - 5.6 percent in real terms, using the inflation rates assumed in the various IRPs. They represent the tax-adjusted weighted average cost of capital or WACC for the utilities. These values are substantially higher than the other entities' rates both because of the large equity component in their capital structures and because their credit ratings on debt are relatively weaker according to the Council.

[29] Per the third review team experience, this approach is mostly included if early replacement is considered for a measure that is typically considered as a replace on burnout (natural replacement).

[30] The PSE 2009 IRP uses a WACC of 8.1%, but the cost-effectiveness analysis used a nominal discount rate of 8.25%.

Methodology Comparison

Since the ProCost calculations are done in macros and there is no documentation for the 2010 review, the review team worked with the Council to help identify the lines of code for the main calculations. Only a cursory review was done. However, the following are itemized by the WSCWG as part of the Council's approach. These are not a part of PSE's existing methodology for 2010.

- Uses beginning of year discounting
- Negative costs are treated as benefits and vice versa
- Costs and benefits are accrued across the different sponsors
- All calculations are for the life of a measure (whereas PSE stops at 30 years)

For both calculators, only at the program level are administrative costs taken into consideration, not at the measure level.

One difference from 2010 and 2011 in the two methodologies is that now PSE uses beginning of year discounting similar to the Council's approach. Additionally, PSE now uses actual measure life and load shape on a measure level to calculate avoided costs instead of an aggregate level within a program, also consistent with the Council's approach.

4.2.2. Calculating TRC Using the ProCost Model

The settlement discusses that PSE's portfolio must pass the TRC test as defined by the Council. Therefore, the project team considered using certain PSE data points and using ProCost at the program level to calculate the TRC from the Pro Cost calculator for comparison of the results. However, the variance in the avoided costs between PSE and the Council surpass any variation we would see in using the ProCost methodology versus PSE. The inputs are the biggest variable, as opposed to methodology. Therefore, PSE is in compliance with the settlement agreement.

If this analysis was done, six ProCost parameters may easily be varied for the analysis: kWh savings, measure life, incremental measure cost, load shape, percentage of administration costs, and discount rate. Assigning a proper load shape that resembled those chosen by PSE (one load shape per program based on the predominant measure type) is challenging as described in the load shape section.

Most ProCost parameters would be unchanged. The nominal Discount Rate would have been at PSE's 8.25% and Regional Act Conservation Credit set to 10%. One set of the ProCost calculations (see below) use the default 20% value of calculating administration costs across the board. However, since PSE is an actual program administrator, these values would vary based on the program.

Table 30: ProCost Inputs

Program Parameters	Value
Program Life (yrs)	20
Program Start Date	2010

Program Parameters	Value
Present Value Time Zero	2010
Input Cost Reference Year	2006
Real Discount Rate	8.25%
Capital Real Escalation Rate	0.00%
Admin Cost (As % of Initial Capital Cost)	20%/Varies
Regional Act Conservation Credit (%)	10%
Report Annual Carbon Saved for Year	2020

Unlike PSE's tests, ProCost splits up cost and other parameters by sponsor as shown in the following table.

Table 31: ProCost Sponsor Parameters

Sponsor Parameters	Customer	Wholesale Electric	Retail Electric	Natural Gas
Real After-Tax Cost of Capital	3.90%	4.40%	4.90%	5.00%
Residential Financial Life (years)	15	1	1	1
Residential Sponsor Share of Initial Capital Cost	35%	20%	45%	0%
Non Residential and Combined Sector Financial Life (years)	20	1	1	1
Non Residential and Combined Sector Sponsor Share of Initial Capital Cost	35%	10%	55%	0%
Sponsor Share of Annual O&M	100%	0%	0%	0%
Sponsor Share of Periodic Replacement Cost	100%	0%	0%	0%
Sponsor Share of Administrative Cost	0%	50%	50%	0%
Last Year of Non-Customer O&M & Period Replacement		20		

The team performed several runs to assess what would be the TRC using the ProCost calculator to ensure that PSE programs are cost-effective per the Council's calculator and as dictated in the settlement agreement, "The Commission uses the TRC, as modified by the Council, as its primary cost-effectiveness test/ PSE's portfolio must pass the TRC test." The following components are part of the input table to do the calculation. Capital cost is the total measure cost of the measures installed. However, the team varied the administration costs for each program analyzed using ProCost.

Table 32: PSE Inputs to Pro Cost

Measure Name	Savings (kwh/yr)	Life (yrs)	Capital Cost	Shape Pointer
Single Family Existing	83,164,576	9	$14,574,090.00	ResLight
Low Income	2,701,016	20	$2,726,219.00	ResSHwx

Measure Name	Savings (kwh/yr)	Life (yrs)	Capital Cost	Shape Pointer
Single Family New Construction	2,632,578	14	$1,255,606.00	ResLight

The results of the TRC benefit to cost-ratio analysis are summarized in the following table.

Table 33: ProCost TRC Output Comparison

Program	PSE	ProCost	Pro Cost, actual admin
SF Existing	1.97	5.2	4.4
Low Income	1.24	1.4	1.3
SF New Construction	2.17	2.4	1.6

ProCost results, as well as the WSCWG TRC comparison analysis, show that the Council approach (and avoided costs values) results in consistently higher TRC values. Since PSE may have different inputs such as the avoided cost values, the team infers that while PSE's approach is conservative, it most likely does not limit its program design due to PSE's provision to include non-energy or un-quantified non-energy benefits to a program's TRC analysis. However, this was not necessary because all 2010 programs were cost-effective above the TRC threshold.

4.2.3. Cost-Effectiveness Inputs and Due Diligence Review

The following inputs are discussed in detail within this section:

- Avoided costs
- Load shapes
- Measure life
- Measure costs
- Administration costs
- Savings and incentives

The team discovered some consistency issues during the review of PSE's cost-effectiveness calculations. These are addressed below by input. The main issue we found is that PSE is not properly incorporating third-party program information into overall portfolio analysis. The information does not align with PSE's reporting parameters. The team includes additional input from the 2011 EES Tracking and Reporting Checklist presented by PSE. The recommendations are discussed in the tracking and reporting processes review in Section 3.1. However, in 2011, reporting (or cost-effectiveness data analysis) was consistent across the programs or at least summarized with consistent level of detail with in most cases measure level information by individual projects.

Avoided Costs

The team reviewed the derivation of average annual avoided costs used in the Appendix D for 2010 and Exhibit 2 for 2011 workbook. These avoided costs values are used to calculate the benefits related to the energy savings. Table 34 and Table 35 show the avoided costs used for each program year, respectively. The first one shows the levelized avoided costs in $/kWh used for 2010, which include both avoided energy and capacity costs. The second one contains the 2011 cumulative NPV avoided costs. These tables do not include the conservation credit of 10%;[31] however, a simple multiplication of these values times 110% yield the avoided costs with conservation credit (used with the TRC calculation).

[31] Conservation Credit of 10% included, based on NW Power Act. See NWPPC, Draft Fourth Northwest Conservation and Electric Power Plan, Appendix G, page G7-5.

Table 34: 2010 Annualized Avoided Energy Costs without Conservation Credit

Measure Life	SF Space Heat	MF Space Heating	Residential Water Heat	Residential Lighting	Residential Heat Pump	Residential Plug Load	Commercial Cooking	Commercial Cooling	Commercial Heating	Commercial Lighting	Commercial Refrigeration	Flat
	SFSH	MFSH	WH	LIGHTING	HP	PLUG	CICOOK	CICOOL	CIHEAT	CILTG	CIREF	FLAT
1	$ 0.127	$ 0.104	$ 0.100	$ 0.084	$ 0.153	$ 0.087	$ 0.078	$ 0.055	$ 0.167	$ 0.103	$ 0.088	$ 0.084
2	$ 0.130	$ 0.106	$ 0.102	$ 0.086	$ 0.156	$ 0.089	$ 0.079	$ 0.057	$ 0.170	$ 0.105	$ 0.090	$ 0.086
3	$ 0.139	$ 0.116	$ 0.111	$ 0.095	$ 0.166	$ 0.098	$ 0.088	$ 0.065	$ 0.180	$ 0.115	$ 0.100	$ 0.095
4	$ 0.145	$ 0.121	$ 0.117	$ 0.100	$ 0.172	$ 0.103	$ 0.094	$ 0.070	$ 0.186	$ 0.120	$ 0.105	$ 0.100
5	$ 0.149	$ 0.126	$ 0.121	$ 0.104	$ 0.176	$ 0.107	$ 0.097	$ 0.074	$ 0.191	$ 0.124	$ 0.109	$ 0.104
6	$ 0.153	$ 0.129	$ 0.124	$ 0.107	$ 0.180	$ 0.110	$ 0.100	$ 0.076	$ 0.195	$ 0.128	$ 0.112	$ 0.107
7	$ 0.156	$ 0.132	$ 0.127	$ 0.110	$ 0.183	$ 0.113	$ 0.103	$ 0.078	$ 0.199	$ 0.130	$ 0.115	$ 0.110
8	$ 0.159	$ 0.135	$ 0.129	$ 0.112	$ 0.187	$ 0.115	$ 0.105	$ 0.080	$ 0.203	$ 0.133	$ 0.117	$ 0.112
9	$ 0.162	$ 0.138	$ 0.132	$ 0.114	$ 0.190	$ 0.118	$ 0.107	$ 0.081	$ 0.206	$ 0.135	$ 0.119	$ 0.115
10	$ 0.164	$ 0.140	$ 0.134	$ 0.116	$ 0.192	$ 0.120	$ 0.109	$ 0.083	$ 0.209	$ 0.138	$ 0.122	$ 0.117
11	$ 0.167	$ 0.142	$ 0.136	$ 0.118	$ 0.195	$ 0.122	$ 0.111	$ 0.084	$ 0.212	$ 0.140	$ 0.124	$ 0.119
12	$ 0.169	$ 0.145	$ 0.138	$ 0.120	$ 0.198	$ 0.124	$ 0.113	$ 0.086	$ 0.215	$ 0.142	$ 0.126	$ 0.121
13	$ 0.172	$ 0.147	$ 0.140	$ 0.122	$ 0.201	$ 0.126	$ 0.115	$ 0.087	$ 0.218	$ 0.144	$ 0.127	$ 0.122
14	$ 0.174	$ 0.149	$ 0.142	$ 0.124	$ 0.203	$ 0.127	$ 0.117	$ 0.089	$ 0.221	$ 0.146	$ 0.129	$ 0.124
15	$ 0.176	$ 0.151	$ 0.144	$ 0.125	$ 0.206	$ 0.129	$ 0.118	$ 0.090	$ 0.223	$ 0.148	$ 0.131	$ 0.126
16	$ 0.179	$ 0.153	$ 0.146	$ 0.127	$ 0.208	$ 0.131	$ 0.120	$ 0.092	$ 0.226	$ 0.150	$ 0.133	$ 0.128
17	$ 0.181	$ 0.155	$ 0.148	$ 0.129	$ 0.210	$ 0.133	$ 0.121	$ 0.093	$ 0.229	$ 0.152	$ 0.135	$ 0.129
18	$ 0.183	$ 0.157	$ 0.150	$ 0.130	$ 0.213	$ 0.134	$ 0.123	$ 0.094	$ 0.231	$ 0.154	$ 0.136	$ 0.131
19	$ 0.185	$ 0.159	$ 0.152	$ 0.132	$ 0.215	$ 0.136	$ 0.125	$ 0.095	$ 0.234	$ 0.155	$ 0.138	$ 0.133
20	$ 0.187	$ 0.160	$ 0.153	$ 0.134	$ 0.217	$ 0.138	$ 0.126	$ 0.097	$ 0.236	$ 0.157	$ 0.140	$ 0.134
21	$ 0.189	$ 0.162	$ 0.155	$ 0.135	$ 0.219	$ 0.139	$ 0.128	$ 0.098	$ 0.238	$ 0.159	$ 0.141	$ 0.136
22	$ 0.191	$ 0.164	$ 0.157	$ 0.137	$ 0.222	$ 0.141	$ 0.129	$ 0.099	$ 0.240	$ 0.160	$ 0.143	$ 0.137
23	$ 0.192	$ 0.165	$ 0.158	$ 0.138	$ 0.223	$ 0.142	$ 0.130	$ 0.100	$ 0.242	$ 0.162	$ 0.144	$ 0.139
24	$ 0.194	$ 0.167	$ 0.160	$ 0.139	$ 0.225	$ 0.143	$ 0.131	$ 0.101	$ 0.244	$ 0.163	$ 0.145	$ 0.140
25	$ 0.196	$ 0.168	$ 0.161	$ 0.140	$ 0.227	$ 0.144	$ 0.133	$ 0.102	$ 0.246	$ 0.165	$ 0.147	$ 0.141
26	$ 0.197	$ 0.170	$ 0.162	$ 0.142	$ 0.229	$ 0.146	$ 0.134	$ 0.103	$ 0.248	$ 0.166	$ 0.148	$ 0.142
27	$ 0.199	$ 0.171	$ 0.163	$ 0.143	$ 0.231	$ 0.147	$ 0.135	$ 0.104	$ 0.250	$ 0.167	$ 0.149	$ 0.143
28	$ 0.200	$ 0.172	$ 0.165	$ 0.144	$ 0.232	$ 0.148	$ 0.136	$ 0.105	$ 0.252	$ 0.169	$ 0.150	$ 0.144
29	$ 0.202	$ 0.173	$ 0.166	$ 0.145	$ 0.234	$ 0.149	$ 0.137	$ 0.105	$ 0.253	$ 0.170	$ 0.151	$ 0.145
30	$ 0.203	$ 0.175	$ 0.167	$ 0.146	$ 0.235	$ 0.150	$ 0.138	$ 0.106	$ 0.255	$ 0.171	$ 0.152	$ 0.146

Table 35: 2011 Avoided Energy Costs without Conservation Credit

Measure Life	Single Family Space Heat	Single Family Heat Pump	Multifamily Space Heat	Residential Water Heat	Residential Plug Load	Residential Lighting	Commercial Space Heat	Commercial Refrigeration	Commercial Cooling	Commercial Cooking	Commcerical Lighting	Commercial Flat
	SF Space Heat	SF Heat Pump	M F Space Heat	Res Water Heat	Plug Load	Res Lighting	Comm Space Heat	Comm Refrigeration	Comm Cooling	Comm Cooking	Comm Lighting	Flat
1	$ 0.117	$ 0.141	$ 0.096	$ 0.092	$ 0.080	$ 0.078	$ 0.154	$ 0.082	$ 0.051	$ 0.072	$ 0.095	$ 0.077
2	$ 0.230	$ 0.277	$ 0.188	$ 0.181	$ 0.157	$ 0.153	$ 0.302	$ 0.160	$ 0.101	$ 0.141	$ 0.187	$ 0.152
3	$ 0.357	$ 0.425	$ 0.297	$ 0.286	$ 0.251	$ 0.244	$ 0.462	$ 0.256	$ 0.167	$ 0.227	$ 0.294	$ 0.243
4	$ 0.477	$ 0.565	$ 0.400	$ 0.385	$ 0.340	$ 0.331	$ 0.614	$ 0.346	$ 0.232	$ 0.308	$ 0.396	$ 0.331
5	$ 0.592	$ 0.698	$ 0.498	$ 0.480	$ 0.425	$ 0.413	$ 0.758	$ 0.433	$ 0.292	$ 0.386	$ 0.493	$ 0.414
6	$ 0.701	$ 0.826	$ 0.593	$ 0.570	$ 0.506	$ 0.491	$ 0.897	$ 0.515	$ 0.349	$ 0.461	$ 0.585	$ 0.493
7	$ 0.806	$ 0.947	$ 0.682	$ 0.655	$ 0.582	$ 0.566	$ 1.028	$ 0.592	$ 0.402	$ 0.531	$ 0.673	$ 0.568
8	$ 0.906	$ 1.062	$ 0.768	$ 0.737	$ 0.656	$ 0.637	$ 1.154	$ 0.667	$ 0.453	$ 0.598	$ 0.756	$ 0.640
9	$ 1.001	$ 1.172	$ 0.851	$ 0.815	$ 0.726	$ 0.705	$ 1.274	$ 0.738	$ 0.503	$ 0.663	$ 0.837	$ 0.709
10	$ 1.091	$ 1.277	$ 0.929	$ 0.890	$ 0.794	$ 0.771	$ 1.388	$ 0.807	$ 0.551	$ 0.725	$ 0.913	$ 0.774
11	$ 1.178	$ 1.377	$ 1.004	$ 0.962	$ 0.858	$ 0.833	$ 1.496	$ 0.872	$ 0.596	$ 0.784	$ 0.986	$ 0.837
12	$ 1.261	$ 1.472	$ 1.075	$ 1.030	$ 0.919	$ 0.893	$ 1.600	$ 0.934	$ 0.640	$ 0.841	$ 1.056	$ 0.897
13	$ 1.339	$ 1.563	$ 1.144	$ 1.095	$ 0.978	$ 0.950	$ 1.698	$ 0.994	$ 0.682	$ 0.895	$ 1.123	$ 0.955
14	$ 1.415	$ 1.650	$ 1.209	$ 1.158	$ 1.035	$ 1.005	$ 1.792	$ 1.051	$ 0.722	$ 0.947	$ 1.187	$ 1.010
15	$ 1.488	$ 1.734	$ 1.272	$ 1.218	$ 1.089	$ 1.058	$ 1.883	$ 1.106	$ 0.761	$ 0.997	$ 1.248	$ 1.063
16	$ 1.557	$ 1.813	$ 1.332	$ 1.275	$ 1.141	$ 1.108	$ 1.969	$ 1.158	$ 0.798	$ 1.045	$ 1.307	$ 1.114
17	$ 1.622	$ 1.888	$ 1.389	$ 1.329	$ 1.190	$ 1.156	$ 2.051	$ 1.208	$ 0.834	$ 1.090	$ 1.362	$ 1.162
18	$ 1.685	$ 1.960	$ 1.444	$ 1.381	$ 1.237	$ 1.202	$ 2.128	$ 1.256	$ 0.868	$ 1.133	$ 1.415	$ 1.208
19	$ 1.745	$ 2.029	$ 1.496	$ 1.431	$ 1.282	$ 1.246	$ 2.203	$ 1.301	$ 0.901	$ 1.175	$ 1.466	$ 1.252
20	$ 1.802	$ 2.095	$ 1.546	$ 1.479	$ 1.326	$ 1.288	$ 2.274	$ 1.345	$ 0.932	$ 1.215	$ 1.515	$ 1.294
21	$ 1.857	$ 2.157	$ 1.593	$ 1.524	$ 1.367	$ 1.328	$ 2.341	$ 1.387	$ 0.962	$ 1.253	$ 1.561	$ 1.334
22	$ 1.908	$ 2.216	$ 1.638	$ 1.567	$ 1.405	$ 1.365	$ 2.404	$ 1.426	$ 0.990	$ 1.289	$ 1.604	$ 1.372
23	$ 1.956	$ 2.271	$ 1.680	$ 1.607	$ 1.442	$ 1.401	$ 2.465	$ 1.463	$ 1.017	$ 1.323	$ 1.646	$ 1.408
24	$ 2.003	$ 2.324	$ 1.720	$ 1.646	$ 1.477	$ 1.435	$ 2.521	$ 1.498	$ 1.042	$ 1.355	$ 1.685	$ 1.442
25	$ 2.046	$ 2.374	$ 1.758	$ 1.682	$ 1.510	$ 1.467	$ 2.575	$ 1.531	$ 1.066	$ 1.385	$ 1.722	$ 1.474
26	$ 2.087	$ 2.421	$ 1.794	$ 1.716	$ 1.541	$ 1.497	$ 2.626	$ 1.563	$ 1.089	$ 1.414	$ 1.757	$ 1.504
27	$ 2.126	$ 2.466	$ 1.828	$ 1.749	$ 1.571	$ 1.526	$ 2.675	$ 1.593	$ 1.111	$ 1.441	$ 1.790	$ 1.533
28	$ 2.163	$ 2.508	$ 1.860	$ 1.780	$ 1.598	$ 1.553	$ 2.721	$ 1.621	$ 1.131	$ 1.467	$ 1.821	$ 1.561
29	$ 2.198	$ 2.548	$ 1.891	$ 1.809	$ 1.625	$ 1.579	$ 2.764	$ 1.648	$ 1.150	$ 1.492	$ 1.851	$ 1.586
30	$ 2.232	$ 2.586	$ 1.920	$ 1.836	$ 1.650	$ 1.603	$ 2.805	$ 1.673	$ 1.168	$ 1.515	$ 1.879	$ 1.611

To calculate these values, multiple steps were taken and are documented within the 2010 "CE Std 10-11_Electric_wo 10% cons credit.xls" workbook[32] and 2011 "CE Std 10-11_Electric_wo 10% cons credit_Bobbi_NPVOFAvoidedCosts.xlsx" workbook.[33] The annual weighted average of hourly price by end use was first determined and then documented within "2010_8760.xls". These are the steps the team used for calculating the avoided demand and energy cost values. The 2011 steps are the same except for step 4.

1. Determine the 30-year forecast of hourly prices (the review of the derivation of these values is presented in Section 4.2 below.
2. Determine the 8,760 load shapes by end use by market sector. The following end uses were used to analyze avoided costs for the above table[34].

SF Space Heat
MF Space Heating
Residential Water Heat
Residential Lighting
Residential Heat Pump
Residential Plug Load
Commercial Cooking
Commercial Cooling
Commercial Heating
Commercial Lighting
Commercial Refrigeration
Flat

3. The load shape value was then multiplied and summed to determine the annual weighted average of hourly price in $/MWh. For some load shapes, some assumptions were used. For example, commercial lighting average is based on office building even though analysis is available for warehouse, university, school, restaurant, hotel, hospital, grocery, and dry goods. This was done to simplify the cost-effectiveness analysis when end use load shapes were similar to each other and did not affect the overall weighted average.

[32] There is also a version of this workbook that addresses the 10% conservation credit in the TRC calculation, titled "CE Std 10-11_Electric_with 10% cons credit.xls".

[33] There is also a version of this workbook that addresses the 10% conservation credit in the TRC calculation.

[34] The load shapes are from the 2009 IRP process.

4. These annual weighted averages of hourly price per year ($/MWh) per end use was then transferred to the calculation spreadsheet. This spreadsheet calculates the avoided costs for energy and capacity, which are then summed to be used as the levelized avoided-cost values for the cost-effectiveness calculations in Appendix D. The 2011 spreadsheet calculates the net present value (NPV) of avoided costs for energy and capacity, which are then summed to be used as the stream of avoided-cost values for the cost-effectiveness calculations based on measure life in Exhibit 2.

   a. To calculate the avoided energy costs, the team used the following inputs and calculations:

Commercial T&D Losses[35]:	6.40%
Residential T&D Losses:	7.90%
Nominal Discount Rate[36]:	8.25%
GDP Inflation[37:]	2.5%
Planning Adjustment[38]:	23%
Conservation Credit[39:]	10.0%

The following discussion describes the spreadsheet calculations to determine avoided energy costs by end use.

Year	Measure Life	Annual Weighted Average of Hourly Price	T&D Line Loss Reduction	Planning Adjustment	Conserv. Credit	NPV - Energy	Cumulative Present Value CES-Energy	Levelized C-E Standard-Energy
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

For each end use described in earlier in bullet 2, a spreadsheet calculates column [9], levelized for 2010 and cumulative NPV for 2011 cost-effectiveness standard-energy. The annual weighted average hourly price [3] is transferred from the work in the “2010_8760.xls” spreadsheet for reducing the 30-year forecast of hourly costs in yearly costs (steps 1-3).

35 T&D Line Loss based on PSE 2009 GRC Cost of Service Energy Allocations 7.90% for residential, 6.4% for commercial/industrial.

36 Nominal discount rate is equal to PSE weighted average long run cost of capital.

37 From the 2009 IRP process.

38 Planning Adjustment calculated by estimating the difference between an all-market, adjusted for firm capacity needs, to an all-supply resource portfolio. This premium is equal to market price plus 23%.

39 Conservation Credit of 10% included based on NW Power Act. See NWPPC, Draft Fourth Northwest Conservation and Electric Power Plan, Appendix G, page G7-5.

- T&D line loss reduction equals [3] x T&D Losses percentage (6.4% for commercial and 7.9% for residential).
- The planning adjustment equals ([3] + [4]) x 23%.
- Conservation credit, if relevant, equals ([3] + [4] + [5]) x 10%.
- NPV of Energy [7] is the net present value of the energy costs for each year, which equals ([3] + [4] + [5] + [6]) / ((1 + nominal discount rate)^[2])
- Cumulative Present Value CES-Energy equals the cumulative values from column [7]. For example, Year 3: this value is the sum of Year 1 to Year 3 of column [7].
- Levelized cost-effectiveness standard-energy equals the PV (discount rate, [2], [8]) or, in other words, the present value of the cumulative values discounted by 8.25% over the term of the measure life (therefore year 1 is equal to year 1 of column [7]). This is only relevant for 2010 data.

b. To calculate the avoided capacity costs ($/MW-yr) the following are the inputs and calculations:

Deferred T&D Cost Credit ($/kw-yr)[40]:	$45.56
NW Power Act Regional Credit[41]:	10.0%
Nominal Discount Rate[42]:	8.25%
GDP Inflation[43]:	2.5%
Reserve Margin Credit[44]:	15.0%

The following table shows the spreadsheet calculation header to determine the avoided capacity cost

Year	Measure Life	Total Annual Capital & Fixed Costs of Capacity	Deferred T&D	Conserv. Credit	Reserve Margin Credit	NPV - Capacity	Cumulative Present Value CES-Capacity	Levelized Cost Effectiveness Standard-Capacity
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

[40] Deferred T&D costs $45.56/kw-yr was developed by the Time-of-Use collaborative group in October 2009, based on PSE analysis of the avoidable portions of T&D capital expenditures for 1990 - 2008. Deferred T&D costs are calculated for the avoided capacity.

[41] Environmental Credit of 10% included. See NWPPC, Draft Fourth Northwest Conservation and Electric Power Plan, Appendix G, page G7-5.

[42] Nominal discount rate is equal to PSE's weighted average long-run cost of capital.

[43] GDP inflation rate is from PSE system load forecast used in 2009 IRP Process.

[44] Capacity Reserve Margin of 15% is required by regulation.

The total annual capital and fixed costs of capacity are transferred from the PSE integrated resource plan. These values are then calculated using the following steps:

- Deferred T&D cost credit equals the previous year's value ($/MW-yr) x 1.025%, where 2.5% is the GDP inflation rate.
- Conservation credit, if relevant, equals ([3] + [4]) x 10%.
- Reserve margin credit equals ([3] + [4] + [5]) x 1.15%.
- NPV-Capacity is the net present value of the capacity costs for each year, which equals [6] / ((1 + nominal discount rate)^[2])
- Cumulative Present Value CES-Capacity equals the cumulative values from column [7]. For example, Year 3: this value is the sum of Year 1 to Year 3 of column [7].
- Levelized cost-effectiveness standard-energy equals the PV (discount rate, [2], [8]) or, in other words, the present value of the cumulative values discounted by 8.25% over the term of the measure life, for 2010 only.

5. The final step required calculating the sum of avoided costs for energy and capacity, which are presented as the levelized/cumulative NPV avoided-cost values for the cost-effectiveness calculations in Appendix D in 2010 and Exhibit 2 for 2011, respectively. However, to add the two avoided-cost values, the capacity cost was converted to an energy cost in $/MWh., PSE selected hour 8576 (December 24, 8am) to do this. PSE determined that this was the actual system peak in 2005 which was the year the system load curve was based on for the 2009 IRP. This load factor per end use was applied to the capacity cost to convert it to the energy avoided costs.

The analysis for avoided costs seems acceptable. The avoided capacity and energy costs are individually assessed, based on a program or measure's annual kWh saved and peak kW saved. However, since PSE does not have a kW goal, and since the region uses an average MW (average value over the year, i.e., annual kWh savings divided by 8760), PSE instead uses the approach described in step 5 above. It may be worthwhile to consider the end-use peak or actual PSE peak as an alternative approach for converting capacity costs ($/kW) to energy costs ($/kWh). While a selected hour approach may balance out across the program portfolio, it may overstate or understate the avoided cost for a particular end use[45]. Further analysis must be completed to assess this assumption.

[45] The 2011 IRP uses a different approach which bases the peak value on the average of December weekday loads during peak hours. This change will be reflected in the 2012-13 program cost-effectiveness analysis.

Measure Life

The measure life determines how many years of savings are expected from a measure. There are several studies that document this value by measure. For cost-effectiveness calculations, this value is the basis for the present value and levelized costs, and benefits calculated.

For this review, the team verified the values entered into the program level for 2010 and measure level for 2011 analysis for C-E calculations, though measure-level tracking systems verification for accuracy of measure life was not completed here. This tracking-system review was discussed previously in Section 3.1. The team reviewed if the proper measure life was used for the overall program to calculate cost-effectiveness. A major difference in PSE's 2011 approach compared to 2010 is that measure life is assessed on the measure level instead of a weighted average or assumed on a program level. For 2010, only two programs had the measure life documented by measure: the single-family and multi-family new construction programs. However, this analysis was completed external to the workbook and rounded for each program.

The team recognizes that measure metrics provide default measure-life values for deemed measures that should be used for all deemed measures and tracked by project to do this analysis. It is encouraged for PSE to have a measure life look-up table for non-deemed measures, too. For example, the California DEER and the Pennsylvania ACT 129 technical resource manual (Appendix A) have such tables.

Load Shape

PSE calculated the cost-effectiveness standard value per kWh for each program using the load shape appropriate for the measure end-use type. In 2010, PSE used the predominant measure end-use type at an aggregate program level. The 2011 approach is more common and consistent with the Council's ProCost calculator.

Since in 2010, the load shape defined at the program level was dictated to be the value of the yearly weighted average avoided costs. While some programs were associated with only one electric end-use type (e.g., LED traffic signals), the majority included a variety of different measures and end-use types. PSE calculated the cost-effectiveness standard value per kWh for each program using the load shape from program's predominant measure end-use type. Our team for the 2010 review compared this approach to taking a weighted average of end-use types using the Single-Family Existing program as an example. This approach more closely aligned with the ProCost and California IOU methods, which define end-use load shapes at the measure level, not the program level.

Table 36: Effects of Changing Weighted Average Avoided Costs by Load Shape

C-E Test	Electric End-Use Type	Cost Eff. Standard Value per kWh	B/C Ratio
Utility Cost	Lighting	$0.11	4.02
	Weighted Average	$0.12	4.38
Total Resource Cost	Lighting	$0.13	1.97
	Weighted Average	$0.14	2.14

These calculations were made using the nine-year measure life assumed by PSE for all measures within the Single-Family Existing Program.

In 2010, the review team believes an error was made in defining dominant end-use types. For the multi-family existing program, the single-family space heat end use was used instead of multi-family space heat (MFSH). When this error was corrected, the UC decreased from 4.04 to 3.46 and the TRC from 2.61 to 2.24.

Regarding 2011, the review team made some general observations. One is that it is unclear if certain measures in commercial programs are predominantly space heat or cooling end uses. Additionally, the flat end-use is used both for commercial and residential applications where other load shapes is not appropriate. The review team recommends adding more end use load shapes to PSE's library to allow for more disaggregation.

The review team believes there were errors in assigning load shapes to certain measures. These instances are listed below:

- Low income weatherization
  - Some multi-family building types were mapped to the single-family space heat end use.
- Multi-family new construction
  - One showerhead project was mapped to commercial light instead of single-family water heat end use.
- Multi-family existing
  - Refrigerator projects were mapped to space heat instead of plug load.
- Clothes washers
  - Electric water heat units were mapped to plug load instead of single-family water heat end use.
- C&I new construction
  - Most measures are not mapped properly.
  - The review team made changes and TRC increased from 2.62 to 2.75.
- C&I retrofit
  - Heat recovery and software measure was mapped to commercial lighting.
  - Water heater insulation mapped to commercial space heat.
- Large Power Use – Self Direct
  - Some measures are ambiguous and should be commercial space heat and not flat.

- C&I Rebates
  - Change from flat end use to commercial space heat for HVAC VSD and PTAC measures.
  - The review team made changes and TRC increased from 2.64 to 3.33.

In all cases, these errors of mis-assigning load shapes occurred because of the manual nature of the process, coupled with thousands and thousands of line items in the tracking system. The overall effect of these mis-assignments is small, and in most cases is on the conservative side. The evaluation team at PSE has developed a protocol to have the tracking systems automatically assign load shapes.

Incremental Measure Costs

The incremental measure costs (IMC) can be either the incremental cost or the full-measure cost. The appropriate value is dependent on the measure application, i.e., retrofit (RET), replace-on-burnout (ROB), or new construction (NEW). The 2008 Summit Blue Consulting report prepared for PSE "Best Practices for Assessing Measure Costs" provides definitions of the proper cost basis for measures. Each program's tracking system should include a field for measure costs. The source of this value may vary by program delivery method, market sector, measure type, or other variables. This report is a good reference for defining the best practices that address measure costs and should be leveraged appropriately. Each program's tracking system should include a field for measure costs. The source of this value may vary by program delivery method, market sector, measure type, and other variables. For the most part, PSE's practices are described here.

1. <u>Residential</u>

   2010

   - Actual measure costs were used for one program—ECOS multi-family existing (E217).
   - Deemed measure costs were used for remaining rebate programs, unless otherwise noted in the program tracking database.

   2011

   - Deemed measure costs were used for programs except for:
     - Fuel conversion (E216)
     - Single family new construction (E215)
   - Single family ARCA Weatherization do not have measure costs
   - Space heat uses deemed values for cost-effectiveness calculations, but collects actual cost in program tracking database

2. Commercial and Industrial

2010 and 2011

Generally for C&I program, the program administrators review the invoices and take out line items that are not relevant to energy efficiency. They add back in taxes and other items, as necessary, allocated across the energy efficiency items on an invoice.

- Grants—PSE uses a review checklist form that indicates if a "cleaning" of the invoice for project cost or to document the incremental cost, if there is a code/standard baseline.
- Rebates where full-measure costs were merited— such as lighting, VFDs, and premium HVAC service—the "cleaned" invoice amount is used.
- Deemed costs are intended to be used with C&I rebates where the choice is high-efficiency versus code or industry standard. This is not always the case however. For HVAC measures, the team used the deemed IMC value. For commercial kitchen equipment however, the full cost from the invoice may be used. Per input from PSE, the C&I group is transitioning from using deemed costs to using the IMC when it is a ROB or NEW type of measure.
- The small business lighting program uses the full-measure cost as reported by contractors participating in the program.

The following recommendations are from the 2010 review team report, and are repeated here, since they are still relevant. Potential solutions from the 2011 EES Tracking and Reporting Checklist presented to the EES group are echoed here to indicate that there is a need to make changes to mitigate any program documentation errors for costs. These recommendations include:

- Default to costs in the incremental cost study, as appropriate.
- Collect costs for small commercial measures.
- Document a methodology for cost assumptions throughout portfolio.
- Ensure documentation describes what may or may not be included as a measure cost.
- Specify when to use incremental versus full cost.
- Specify when to default to deemed value.
- Require itemized invoices beginning in 2012 for all residential items, as appropriate.
- Consider requiring an itemized invoice for C&I measures with a cost estimate of standard equipment.[46]

[46] The review team leaves the decision to the program designers.

Per the review team's experience, most programs that use deemed savings also use deemed incremental measure costs for reporting purposes. It is recommended that PSE review the potential impacts of changing its practice of assessing measure costs per the above recommendations, such as incorporating contractor bonus or when to use full versus incremental or deemed versus actual costs. For non-deemed measures, actual costs (incremental if appropriate) should be recorded and used for cost-effectiveness analysis.

Administrator Costs

PSE considers administrative costs to be all costs attributable to a program except for incentives or other direct benefits to customers (such as removing second refrigerator for free). This would include all marketing costs, labor, materials, office supplies, and outside services that it takes to run a given program. Program costs are tracked by order numbers in PSE's internal accounting system. All program overhead costs are hard coded. The review team understands that an audit of PSE's accounting of administrator costs has been conducted and will not be duplicated here. Therefore, these represent a significant variable of total program cost-effectiveness. The following is a table that summarizes the costs for the two program years. There is a significant increase from one year to the next.

Table 37: Administrator Costs as a Percent of Measure and Program Costs

Program Year	% of Total Measure Costs	% of Total Program Costs
2010	14%	16%
2011	23%	30%

Incentives and Energy Savings

The incentive value is considered only in the UC test. This review did not examine incentive and savings values. Savings were reviewed during the project-level portfolio review discussed in Section 1.1. It is assumed that the database tracking reports used for Appendix D captured the incentive payments correctly. Their correct assignment or calculation was completed under the cost-effectiveness review. All program incentive costs and savings are traceable back to a sum of individual measures for each project within the workbook except for the 2010 Low Income program, which is hard coded. Additionally, E214, single-family rebates were not detailed in the 2010 Appendix D calculations. In 2011, more detailed workbooks are available for all programs, for review, too. Traceable data was more easily available for the 2011 review. However, the savings and incentives were verified via database extracts gathered for the portfolio savings review.

4.2.4. Settlement Agreement Compliance

Key items for PSE to be in compliance per the Settlement Agreement are listed below.

1. Pass the TRC test and be consistent with the Council's methodology.
   - In 2010, PSE is consistent with the Council's methodology. Differences include:
     - Average annual avoided costs versus four segments monthly
     - Non-energy benefits are not included
     - Program level calculations, not measure level
     - O&M costs are not included
   - For 2011,PSE is consistent with the Council's methodology with the following updates:
     - Measure level calculations (not program level)
     - Use beginning of year calculations
     - Use cumulative NPV avoided costs instead of levelizing all costs for cost-effectiveness ratio calculations
   - The 2011 differences from the Council's methodology include:
     - Hourly annual avoided costs versus four segments monthly by end use load shape
     - Council has more disaggregated load shapes
     - Non-energy benefits are not included
     - O&M costs are not included
2. Provide TRC, PAC (UC), PCT, and RIM. The latter two are only required starting in 2012 within the definitions provided by NAPEE.
3. Cost effective on program and portfolio level
4. Follow compliance of definitions for "cost-effectiveness" and "system cost."

PSE has met all of these requirements, and their methodology is consistent with Council guidance for TRC calculation. See Section 5 below for details on methods, models, and assumptions for the associated avoided costs.

5. Avoided Cost Review

The objective of this review was to examine PSE's approach to calculating avoided costs, and assess whether they conformed to the Council methodology. This section describes how the review team carried out this review, and presents the corresponding findings. This review was performed using 2010 avoided cost information, and applies to 2011 as well, since PSE used the same values for both years.

5.1. Methodology

Introduction and Overview

PSE and the UTC determined that the third-party review should cover PSE's integrated resource plan (IRP) approach to calculating avoided costs. We identified the elements for comparison between the IRP and Northwest Power Council 6th Plan methodology and inputs to developing avoided energy and capacity costs.

The review team reviewed the development of avoided-costs for PSE and the Northwest Power and Conservation Council (Council) as part of a broader evaluation review. The purpose was to understand the degree to which Puget Sound Energy (PSE) conformed to Council forecasting methods.

Avoided costs from these planning efforts provide the benefits for cost-effectiveness calculations and, as a result, help determine the level of energy efficiency (EE) that will be targeted for implementation over the next two years. For example, which is more cost-effective for meeting energy demand – reducing kWh through energy efficient equipment upgrades, by purchasing energy in the open market, or building generation powered primarily by natural gas or wind?

In both cases, avoided costs were a direct result of the integrated resource planning (IRP) process. .The primary differences between the two planning processes are that PSE develops and implements a plan for its service territory, while the Council does not implement the plan directly for states within its territory: Washington, Oregon, Idaho and Montana.

The review team compared the approach of each planning process along several dimensions to identify similarities and highlight any significant differences that would likely lead to significantly different outcomes. In other words, would a difference in inputs or approach lead to outcomes that would change the resource planning or EE investment decisions of either organization at the regional level. We reviewed the most recent plans to be used in the 2012-13 planning cycle. Since the methods did not change significantly from the 2010-11 planning cycle, the broader findings in this review are applicable to the 2010-11 cycle plans as well.

Specifically, for the 2011 IRP for PSE and the Council's Sixth plan, we looked at each:

- Modeling approach including software, parameters, and assumptions.
- Input assumptions to compare sources, magnitudes, and types.
- Areas where additional information would increase the transparency of output development

The 2011 IRP mostly relied on the 2009 IRP assumptions and inputs. Therefore, an additional comprehensive review of the 2009 IRP was not conducted. The 2009 IRP was the source of data for the 2010 program cost-effectiveness analysis.

This section summarizes our findings along with comparison tables and questions for further research.

Uncertainty

A discussion of power planning in the Northwest is not complete without addressing the uncertainty, beyond standard load forecasting, that the region faces. In addition to supplying adequate power, energy planning in the Northwest must include several elements that are beyond the direct control of the utility. Specifically, resource planning must incorporate renewable portfolio standards (RPS), fish and wildlife impacts, and transmission constraints. All of these are influenced by factors not directly managed by the utilities. Examples are:

- Weather and economic activity in the case of wildlife.
- Actions of third-party agencies, such as the Bonneville Power Authority (BPA) in the case of transmission and rapid technological advances
- Policies determined in the political arena for renewable generation development and carbon pricing policies.

5.2. Findings

Modeling Approach

Overall, PSE and the Council use a robust approach to develop their resource plans. Both approaches start with industry standard software to develop price forecasts and evaluate sensitivities. In addition, both use these forecasts as inputs to model portfolios uncertainty and to incorporate risk. A high-level overview of each entity's approach is listed below.

PSE

1. AURORAxmp®[47] is used to generate hourly electric price forecasts. These forecasts include renewable sources and are subject to constraints on coal resources. Outputs from this model are used as inputs in (2).
2. PSE uses an internally developed stochastic model built in SAS. This model generates multiple data sets where the operating parameters (load, CO2 prices, energy prices, and supply sources) can vary. These "random" datasets become inputs to be evaluated in (3).

[47] AURORAxmp Electric Market Model is a software package developed by EPIS, Inc. to produce electric market price forecasts, value analysis, uncertainty analysis, and automated system optimization functionality.

3. Portfolio Screening Model III is another internally developed spreadsheet based model that uses the distribution of datasets generated in (2) and identifies the optimal resource mix based on financial criteria for revenue requirements.

The Council

1. Wholesale hourly electricity prices are forecast using AURORAxmp and are reviewed by the Council's advisory committee. Outputs are the basis for the Council's Regional Portfolio Model (2).
2. The Regional Portfolio Model generates "futures" that are simulated 750 times using a stochastic (Monte Carlo) approach with the Microsoft Excel add-in Crystal Ball. The resulting "scenarios" are evaluated in step (3).
3. The least-cost, risk-constrained resources plan is identified using a non-linear optimization technique calculated by another Excel spreadsheet augmented with the OptQuest add-in until the "risk-indifferent" least-cost plan has been identified.

The modeling approaches for both entities are conceptually similar. Both use AURORAxmp to generate hourly electricity forecasts. Both address uncertainty using scenario analysis, and both incorporate risk when generating optimal resource mix. The differences are found in the assumptions that form the foundations for the forecasts, and these are discussed in the inputs section.

Variation in the handling of variables in each step is beyond the scope of this study, but detailed information on data management and procedures can be found in Appendix I of the 2011 IRP for PSE and in Appendix L of the Council's fifth plan. The Council's discussion in the sixth plan is limited to modeling enhancements made since the fifth plan.

The next aspects to consider are the input data sources and the comparability of inputs into these forecasting models.

Input Data Sources

Each entity uses different sources as inputs into their planning process. Even though each forecast is for the approximately same time period (2010-2030), each forecast covers a different geographical area and is subject to varying degrees of economic and environmental factors. Specifically, PSE is forecasting the Puget Sound region of western Washington state while the Council must inform the entire four-state region. Table 38 lists the sources used and the inputs they are used for.

Table 38: Resource Plan Input Data Sources

Inputs	PSE	NPCC
National economic growth	Moody's	HIS Global Insights[48]
Population growth	Washington State Office of Financial Management	HIS Global Insights
Regional growth	PSE internal	HIS Global Insights
Inflation	Seattle CPI	HIS Global Insights
Regional load	Council's 6th Power Plan	Energy 2020 with Global Insights U.S. business demographics forecast
Gas prices	Wood Mackenzie forecasts	Henry Hub, Sumas, AECO, and the Rocky Mountains trading hubs
Peak load	PSE econometric models Simple-cycle turbines	Energy 2020 demand module Combined- and simple-cycle turbines
CO_2	EPA estimates	Retained EcoSecurities Consulting Limited
Wholesale Electric Prices	AURORAxmp	AURORAxmp
Resource Mix	Portfolio Screening Model III	Resource Portfolio Model Genesys for hydroelectric modeling

Input Assumptions

These assumptions are presented for comparison purposes only and are not expected to be exactly the same for each entity. To reiterate, the PSE forecast is for a sub-region of the Council's forecast. In general, however, the PSE forecast incorporates higher annual average increases in each of the basic parameters compared in Table 39: Input Assumptions. Higher values for these parameters will lead to higher avoided costs and greater investment in generation alternatives, such as energy efficiency. The exception to this is the discount rate where a higher value will reduce the present value of avoided costs and therefore reduce the cost-effectiveness of EE measures, compared to a lower discount rate value.

[48] NPCC Sixth plan series used include;

- SEDS – State Energy Demands from EIA
- SEPER – State Energy Prices from EIA
- FERC Form 1 - Electric Company Data from EIA
- AP 42 – Emissions Data from EPA
- RECS - Residential data from EIA
- CECS – Commercial data from EIA
- MECS – Manufacturing data from EIA

Table 39: Input Assumptions

Assumption	PSE	Council
Electric energy growth (demand)	2.1% per year[49]	1.2% per year[50]
Electric peak load growth	1.7% per year[51]	1.1% per year[52]
Electricity price increase	3.7-6.2% through 2014 2.1-2.6% after[53]	1% per year[54]
Transmission position	Constrained	Constrained
Electric transmission line losses	6.8%[55]	1.9-7.0% depending on resource type[56]
Carbon prices	$18/ton in 2013 $69/ton in 2031[57]	$20/ton in 2013 $47/ton in 2030[58]
Discount rate	Calculated at 8.1% nominal* pre-tax using PSE internal weighted average cost of capital[59] Real = 5.6% (8.1-2.5)	Calculated at 5.0% real* pre-tax using market rate estimate for various entity types[60]
Inflation rate	2.5%[61]	2.5%[62]
Investment tax credits	30% through 2012[63] Resource type not specified	30% solar through 2016 0% wind[64]
Production tax credits	Wind $21/MWh end in 2012[65]	Wind $21/MWh end in 2012[66]

*Real interest rate = Nominal interest rate – inflation (expected or actual)

49 PSE IRP 2011 DRAFT, figure H-5, page H-12

50 Council Sixth plan, 2010, table 3-3, page 3-5

51 PSE IRP 2011 DRAFT, figure H-8, page H-12

52 Council Sixth plan. 2010, page 3-7

53 PSE IRP 2011 DRAFT, page H-5

54 Council Sixth plan, 2010, page 2-17

55 PSE IRP 2011 DRAFT, page H-6

56 NPCC Sixth plan, 2010, page 6-45

57 PSE IRP 2011 DRAFT, page 4-7

58 Council Sixth plan, page 2-9

59 PSE IRP 2011 DRAFT, page I-27

60 Council Sixth Plan, page N-8 (commercial, residential, industrial)

61 PSE IRP 2011 DRAFT, 4-11

62 Council Sixth Plan, page B-36

63 PSE IRP 2011 DRAFT, 4-12

64 Council Sixth Plan, page B-36

65 PSE IRP 2011 DRAFT, I-8

66 Council Sixth Plan, page 6-20, 9-19

Additional Comments and Recommendations

To provide additional transparency, we recommend that the following be included in any new documentation of avoided-costs calculations:

- Currently both entities use levelized avoided costs in their benefit/cost calculations. When applied properly these value yield the same results benefit/cost results as cumulative net present values. Regardless of the metric used, PSE and the Council should document the reason for their choice of method.
- PSE includes a planning adjustment factor of 23% on avoided costs to account for the difference between meeting forecast demand by building additional capacity or through purchases in the wholesale market. This factor was developed in PSE's 2009 IRP. It is driven by the costs of acquiring wind generation and combined cycle combustion turbines.[67] This adder also includes emission control costs for both planning scenarios.
- Both entities mention environmental benefits in addition to carbon prices, but these are not defined or quantified in either plan. PSE uses the 10% Power Act credit as a proxy for additional unquantified environmental benefits. The Power Council's approach is to apply this credit also, but it is in addition to any quantifiable environmental benefits.
- The PSE avoided cost values increase approximately 25% in 2012 and remain higher than the Council's values through 2030. According to PSE, this increase is due to the inclusion of carbon costs in the 2009 IRP's wholesale power price forecast starting in 2012 and was based on anticipation of US Federal climate change bill being enacted in 2011.[68] In light of the current state of U.S. federal climate change legislation, inclusion of this assumption should be revisited. The approximate avoided cost values without the carbon costs are shown in Figure 11 along with current avoided cost values.

[67] Based on phone conversations with PSE staff, 7/21/2011.

[68] Based on phone conversations and email correspondence with PSE staff, 7/21 - 7/22, 2011.

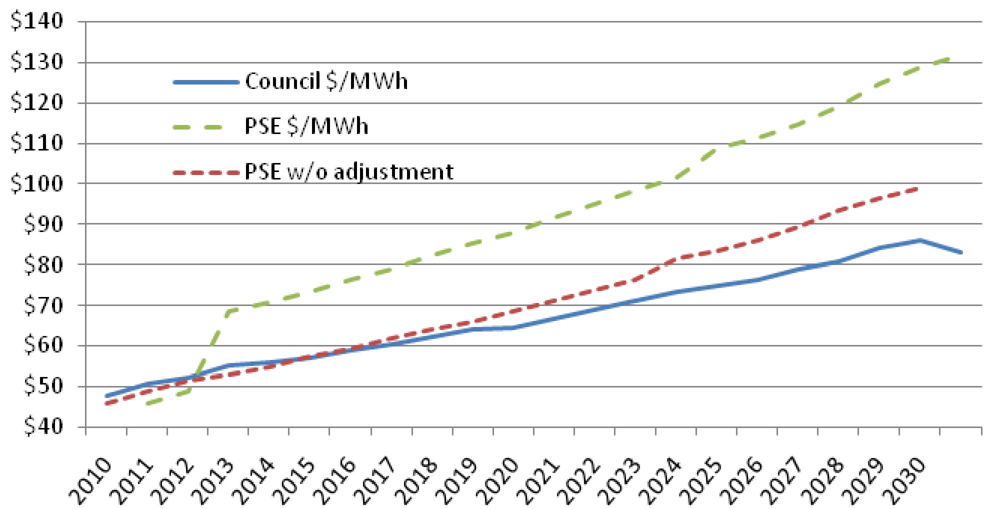


Figure 11: Avoided Cost Schedules.

The review team reviewed the avoided-cost methodology for PSE and the Council. Both entities apply a robust approach to their forecasting process. In addition to forecasting load growth and peak, each entity addresses uncertainty and risk through simulation and sensitivity analysis. Both entities provide extensive documentation on their assumptions and process. Both forecasts point to energy efficiency as a way to address the region's growing energy needs. Both forecasts suggest that wind has the potential to be a viable option but hurdles remain due to the uncertainty surrounding federal policy toward renewable generation. Another hurdle is the fact that existing transmission constraints exist to carry renewable power, and these can be resolved only through decision by, and coordination with, third parties, such as BPA.

PSE and the Council use different sources for model inputs, but this is not unexpected given that each entity is modeling a slightly different region. Overall, we found consistencies between approaches, reasonable assumptions, credible sources, and sufficient documentation details.

6. Conclusions and Recommendations

Drawing from project file reviews, on-site verification, and detailed reviews of two programs of particular interest, the review team has thoroughly assessed the claimed savings in PSE's electric energy efficiency portfolio for the 2010-11 biennium, as required by the settlement agreement. This review was an expansive effort, consisting of a review of nearly 500 project files and thousands of program documents, on-site visits to nearly 300 projects, and dozens of interviews of PSE staff and selected customers. We note that throughout the yearlong process, PSE staff were unfailingly cooperative, prompt, and forthcoming in responding to the review team's numerous requests for information.

Generally, we have verified that PSE's 2010-11 savings claim is sound, defensible, and well-documented. This includes an increase to claimed 2011 Home Energy Report savings based on very recent evaluation results, which the review team validated. We periodically uncovered small documentation discrepancies, but these were minor and in our minds were not symptomatic of larger systemic problems that could call into question the veracity of the claimed savings for a program. Considering the breadth and depth of the scrutiny PSE received during the third-party review process, this is remarkable, and speaks well to the management and procedures.

The only exception is savings associated with the Resource Conservation Manager Program (Tariff E253), which accounts for 7% of the total electric savings for the biennium. While this program appears to us to be popular, well-run, and offering important services to the commercial sector, we were concerned that the savings may be overstated. We understand the extreme difficulties inherent in quantifying savings from such a program, and appreciate the uncertainties in doing so. Nonetheless, we feel that some reduction of the RCM savings claim is warranted. Based on our re-analysis of the data supporting the PSE RCM claim, a reduction within the range of 0% and 35% deserves consideration. Given the uncertainty in this range that stems from schedule and scope limitations, choosing a value for this adjustment is ultimately a qualitative judgment, and should not replace the results of a full impact evaluation, In any event, the overall effect of this adjustment to the portfolio savings is minor: a potential adjustment in the middle of the range would reduce portfolio savings by about 1.2%. Table 40 provides a summary of the portfolio savings review, including this adjustment. It is important to note that regardless of the RCM adjustment made (within the stated range), the PSE 2010-11 portfolio will have exceeded its electric savings target of 622,000 MWh.

Table 40: Summary of Portfolio Savings Review

Tariff	Program	% of claimed 2010-11 savings verified [a]	Claimed savings (MWh)	Verified savings (MWh)
E200	Residential Information Services	100%	-	-
E201	Low Income Weatherization	100%	6,417	6,417
E202	Energy Education	100%	-	-
E214	Single Family existing	100%	-	-
	Home-print, Water Heat	100%	5,139	5,139
	Residential EE Lighting Rebate	100%	142,562	142,562
	Space Heat	100%	10,526	10,526
	Refrigeration Decommissioning	100%	8,303	8,303
	Primary Refrigerator Replacement	100%	469	469
	Energy Star Clothes Washers	100%	6,129	6,129
	Showerheads	100%	4,389	4,389
	Weatherization	100%	15,810	15,810
E215	Single Family New Construction	100%	4,174	4,174
E216	Single Family Fuel Conversion	100%	4,770	4,770
E217	Multi Family Existing	100%	28,942	28,942
E218	Multi Family New Construction	100%	3,634	3,634
E249	Pilots	100%	-	-
	Other than Reports	100%	480	480
	Home Energy Reports	100%	7,034 [b]	7,034
All Residential		**100%**	**248,778**	**248,778**
E250	Commercial/Industrial Retrofit	100%	162,214	162,214
E251	Commercial/Industrial New Construction	100%	35,230	35,230
E253	Resource Conservation Manager Services	83% [c]	45,360	37,422
E255	Small Business Lighting Rebate	100%	50,237	50,237
E257	LED Traffic Signals	100%	1,510	1,510
E258	Large Power User - Self Directed	100%	9,998	9,998
E260	Commercial Energy Efficiency Information	100%	-	-
E262	Commercial Rebate	100%	44,098	44,098
All Business		**98%**	**348,646**	**340,708**

Tariff	Program	% of claimed 2010-11 savings verified [(a)]	Claimed savings (MWh)	Verified savings (MWh)
E254	Northwest Energy Efficiency Alliance (NEEA)	100%	47,000	47,000
Various	Efficiency support and other related activities	100%	-	-
TOTAL		**99%**	**644,424**	**636,486** [(d)]

(a) Includes findings from targeted on-site verification (Section2.3) and detailed reviews (Sections 2.4 and 2.5).

(b) This figure adjusted upwards from 5,093 MWh in 2011 Annual Report, based on independent evaluation results that became available in April 2012.

(c) Assumes an adjustment of 17.5%, which is midway between the PSE claimed savings and the adjustment calculated by the review team. This is based on an expectation that the actual savings lies somewhere in between these two points, but the true value has not yet been established.

(d) Note that this value exceeds PSE's two-year savings target of 622,000 MWh by 2.3%. Even if a more aggressive reduction of 35% on the RCM claim were applied, PSE would still exceed their target.

The review team found that PSE's approach to determining cost-effectiveness and avoided costs was sound, and in compliance with Council methodology. In examining tracking and reporting practices, measure installation verification, and evaluation planning, however, the team found a number of areas of potential improvement, at least compared with how these were carried out in 2010-11, and developed recommendations for addressing these areas. We also found strong evidence that PSE has made significant changes to bolster their practices in these areas. Table 41 summarizes the review team's findings for each major topic reviewed.

While many of the recommendations listed below have been apparent to PSE for some time, they are summarized below for the sake of completeness. The recommendations listed below are consolidated across the various review elements, since similar issues came up in different contexts. Details of the recommendations can be found in the corresponding sections.

Table 41: Summary of Review Findings

Report section	Topic	Overall findings
2.1	Portfolio savings	Claimed savings match the program tracking data, with a few inconsequential exceptions. Final adjusted HER program savings were judged valid, based on a review of evaluation results. NEEA savings were not included in the review.
2.2	Project file reviews	Sampled project files match up well with claimed savings, and provide reasonable supporting documentation.
2.3	On-site verification	On-site observations were consistent with PSE documentation. Infrequent discrepancies were not significant, and did not appear to be systemic.
2.4	E253 – Resource Conservation Manager program	Claimed savings are overstated because of suspect savings calculation methodology. Program should improve documentation and revise savings estimation protocol. A full program evaluation is recommended as soon as possible to better understand realized energy savings.

Report section	Topic	Overall findings
2.5	E215 – SF New Construction program	Claimed savings are valid for large builder's projects in this program.
3.1	Tracking and reporting processes	Affirmed PSE's internal review recommendations for improvements in definitions, documentation, integration, and QC. Rapid program growth has posed challenges, but PSE management is attentive to these and is taking steps to rectify them.
3.2	Measure installation verification procedures	No evidence that verification procedure shortcomings led to improper savings claims. PSE has already taken major steps to standardize and buttress weaknesses in verification systems.
3.3	Evaluation planning and application	Past evaluations to inform 2010-11 programs were minimal, often lacked documentation, and were narrowly defined. PSE has ramped up M&V since then, and formalized planned activities.
4	Cost-effectiveness calculations	Calculations conform to Settlement Agreement and are consistent with Council guidance. Some load shapes were mis-assigned, but their impact was small, and would increase cost-effectiveness. PSE is addressing this issue. 2011 cost-effectiveness information submittal was improved over 2010.
5	Avoided cost	PSE's approach is consistent with the Council's, and used reasonable assumptions, credible sources, and sufficient documentation details.

Overview of recommendations

Portfolio savings

- Revise savings calculation methodology and documentation for RCM program.
- Investigate problems identified during on-site verification visits with residential duct sealing and particular commercial lighting measures.
- Investigate whether current showerheads unit energy savings apply to future initiatives similar to the 2011 Holiday Outreach program, and if not, determine more appropriate savings values.

Tracking and reporting processes

- Develop consistent and complete program tracking databases.
- Carefully document how to use tracking systems.
- Integrate all program data.
- Ensure data quality consistent with best practices.

Measure installation verification

- Improve documentation of verification and inspection processes.
- Enhance and standardize verification, particularly for third-party programs.

Evaluation planning and application

- Assess and monitor implementation of new evaluation efforts.
- Accelerate comprehensive evaluation of RCM program.

Cost-effectiveness calculations

- Develop a consistent approach for determining incremental measure cost across programs and measures, both for third-party and internal programs.
- Consider using weighted average avoided cost based on the mix of end uses within a program.
- Provide additional documentation for future avoided cost calculations.

Report by SBW CONSULTING, INC.

Report No. 1201

FINAL REPORT – VOLUME II

INDEPENDENT THIRD-PARTY REVIEW OF PSE'S 2010-2011 ELECTRIC CONSERVATION ENERGY SAVINGS

Submitted to

PUGET SOUND ENERGY
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BELLEVUE, WASHINGTON 98004

Submitted by

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May 30, 2012

ENERGY + WATER + EFFICIENCY

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APPENDICES

A. Excerpts from Electric Conservation Settlement Agreement

Excerpts from portions the WUTC Settlement agreement with PSE and other stakeholders that are particularly germane to this review are provided in this appendix. The header for each excerpt contains the citation and a brief summary.

AGREED CONDITIONS FOR APPROVAL OF PUGET SOUND ENERGY, INC.'S 2010-2011 BIENNIAL ELECTRIC CONSERVATION TARGETS UNDER RCW 19.285
DOCKET NO. UE-100177

AND AGREED MODIFICATIONS TO ELECTRIC SETTLEMENT TERMS FOR CONSERVATION IN DOCKET NO. UE-011570

E.(9) – avoided cost calculation consistent with Council methodology and EIA (I937).

E. Avoided Cost Calculation

9. To determine which energy efficiency programs and measures are cost-effective, PSE shall rely on a calculation of avoided cost consistent with the Council methodology and with the Energy Independence Act.

K.(3)(a)(i)(2) – modification of existing, or development of new EM&V protocols, based on current EM&V approach.

K. Conditions

(3) **Advisory Group**.

(a) PSE must maintain and use an external conservation Advisory Group of stakeholders to advise the Company on the topics described in subparagraphs (i) through (ix) below. To meet this condition, PSE shall continue to use its Conservation Resources Advisory Group (CRAG), initially created under Docket UE-011570 and UG-011571, and its Integrated Resource Planning Advisory Group created under WAC 480-100-238. The Advisory Groups shall address but are not limited to the following issues:

(i) (1) Development of a written framework for evaluation, measurement, and verification (EM&V) as implemented by PSE which guides its approach to evaluation, measurement, and verification of energy savings. This framework must be reflected in the Biennial Conservation Plan for the next biennium, 2012-2013, and

(2) Modification of existing or development of new EM&V conservation protocols based on PSE's current evaluation, measurement and verification approach.

K.(6)(b) – use RTF deemed electrical savings, except as allowed in the next condition.

(6) **Approved Strategies for Selecting and Evaluating Energy Conservation Savings.**

(b) Except as provided in Paragraph (6)(c) below, PSE must use the Council's Regional Technical Forum's ("RTF's") "deemed" savings for electricity measures. As of the date of this Agreement, the RTF maintains a Web site at http://www.nwcouncil.org/energy/rtf/.

K.(6)(c) – RTF deemed can be superseded if based on generally accepted impact evaluation data and/or other reliable and relevant source data. Must be presented to CRAG for comment.

(c) If PSE uses savings estimates that differ from those established by the RTF, such estimates must be based on generally accepted impact evaluation data and/or other reliable and relevant source data that has verified savings levels, and be presented to the CRAG for comment.

K.(6)(e) – CRAG can review/advise on development of EM&V protocols per K.(3)(a)(i).

(e) PSE must provide opportunities for the CRAG to review and advise on the development of evaluation, measurement and verification protocols for conservation programs. See Paragraph 3(a)(i) above.

K.(6)(f) – annual EM&V on multi-year schedule so that over evaluation cycle, all major programs are covered. 1-3% on electric EM&V expenditures, detailed descriptions of EM&V policies and protocols to CRAG for review.

(f) PSE must perform EM&V annually on a multi-year schedule of selected programs such that, over the EM&V cycle, all major programs are covered. The EM&V function includes impact, process, market and cost test analyses. The results must verify the level at which claimed energy savings have occurred, evaluate the existing internal review processes, and suggest improvements to the program and ongoing EM&V processes. Evaluation reports involving analysis of both program impacts and process impacts of the programs evaluated in the prior year must be part of the Annual Report on Conservation Acquisition described in Paragraphs 8(c) and (g) below.

i. **Evaluation** - PSE must spend between one (1) and three (3) percent of its electric conservation program budget on electric evaluation activities, as defined in the Company's Biennial Conservation Plan, including a reasonable proportion on independent, third-party evaluation reports. For this calculation, the electric conservation program budget consists of non-NEEA conservation programs that have or may have electric energy savings. PSE may ask the Commission to modify this spending band following full CRAG consultation.

ii. **Measurement & Verification** - In accordance with Paragraph 3(a)(i)(1) above, PSE shall provide detailed descriptions of its measurement and verification (M&V) policies, protocols, guidelines and processes to the CRAG for review and advice. Additionally, PSE shall provide to the CRAG an estimate of the costs associated with the detailed M&V plan and PSE will maintain M&V activities at levels that are at least commensurate with regional peers.

K.(6)(g) – third-party review of 2010-11

(g) A one-time only, independent third-party evaluation of portfolio-level electric energy savings reported by PSE for the 2010–2011 biennial period, from existing conservation programs operated during that period, shall be conducted to verify those savings. The independent third-party evaluator shall be selected through an RFP process. The review will be funded by the PSE Electric Conservation Service Rider. The review will be managed by UTC and PSE staff with input on the scope, cost, RFP development, evaluator selection and ongoing oversight by the CRAG. The scope shall:

i. focus on portfolio level EM&V of the existing 2010-2011 PSE conservation portfolio regarding impact, process, market, and cost-effectiveness analysis,

ii. examine selected existing 2010-2011 programs or measures in more depth than others, as called for in the RFP, and

iii. provide for some additional but limited detailed independent EM&V study at the program or measure level to be selected by the independent third-party evaluator from the Company's existing 2010-2011 programs.

This evaluation shall include a review of the Company's reported electric savings on a semi-annual basis, with results provided to Commission staff and PSE and then discussed with the CRAG. A final report for the entire 2010-2011 biennium shall be submitted as part of the Company's two-year report on conservation program achievement, required by Paragraph (8)(h) below. This condition terminates after the final report is submitted. The report shall be finalized and made available no later than June 2012 and may be implemented in phases and delivered as a final product at an earlier date, as needed by PSE. Funds spent in meeting this condition shall count toward PSE's expenditures required under Paragraph (6)(f)(i) above.

K.(7)(d) – methodology for Total Resource Cost test

(7) **Program Design Principles**

(d) Conservation Efforts without Approved EM&V Protocol — PSE may spend up to ten (10) percent of its conservation budget on programs whose savings impact has not yet been measured, as long as the overall portfolio of conservation passes the Total Resource Cost (TRC) test as modified by the Council. These programs may include information-only, behavior change, and pilot projects.

(i) Information-only services refers to those information services that are not associated with an active incentive program or that include no on-site technical assistance or on-site delivery of school education programs. Information-only services and behavior change services shall be assigned no quantifiable energy savings value without full support of the CRAG.

(ii) If quantifiable energy savings have been identified and Commission-approved for any aspect of such programs, the budget associated with that aspect of the program will no longer be subject to this ten percent spending restriction.

The Company may ask the Commission to modify this spending limit following full CRAG consultation. As of the date of this Agreement, an outline of the major elements of the Council's methodology for determining achievable conservation potential, including the Total Resource Cost test, is available on the Council's Web site at http://www.nwcouncil.org/energy/powerplan/6/supplycurves/I937/CouncilMethodology_outline%20_2_.pdf.

K.(8)(h) – third-party review report must be filed by 6/1/2012.

(8) **Required Reports and Filings**

PSE must file the following:

(h) Two-year report on conservation program achievement by June 1, 2012. This filing is the one required in WAC 480-109-040(1) and RCW 19.285.070, which require that the report also be filed with the Washington Department of Commerce.

K.(10)(a) – primary cost-effectiveness test is TRC per Council's approach.

(10) **Cost-Effectiveness Test is the Total Resource Cost (TRC) Test**

(a) The Commission uses the TRC, as modified by the Council, as its primary cost-effectiveness test. PSE's portfolio must pass the TRC test. In general, each program shall be designed to be cost-effective as measured by this test. PSE must demonstrate that the cost-effectiveness tests presented in support of its programs and portfolio are in compliance with the cost-effectiveness definition (RCW 80.52.030(7))[69] and system cost definition (RCW 80.52.030(8))[70] and incorporate, quantifiable non-energy benefits, the 10 percent conservation benefit and a risk adder consistent with the Council's approach. An outline of the major elements of the Council's methodology for determining achievable conservation potential, including the Total Resource Cost test, is available on the Council's website at http://www.nwcouncil.org/energy/powerplan/6/supplycurves/I937/CouncilMethodology_outline%20_2_.pdf.

K.(10)(b) – also provide portfolio CE calculations using UC, RIM, PC tests.

(b) In addition to the Council-modified TRC, PSE must provide portfolio calculations of the Program Administrator Cost test (also called the Utility Cost test), Ratepayer Impact Measure test, and Participant Cost test described in the National Action Plan for Energy Efficiency's study "Understanding Cost-effectiveness of Energy Efficiency Programs." The study is available on the Web site of the United States Environmental Protection Agency at http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf.

[69] "Cost-effective" means that a project or resource is forecast:

(a) To be reliable and available within the time it is needed; and

(b) To meet or reduce the electric power demand of the intended consumers at an estimated incremental system cost no greater than that of the least-cost similarly reliable and available alternative project or resource, or any combination thereof.

[70] "System cost" means an estimate of all direct costs of a project or resource over its effective life, including, if applicable, the costs of distribution to the consumer, and, among other factors, waste disposal costs, end-of-cycle costs, and fuel costs (including projected increases), and such quantifiable environmental costs and benefits as are directly attributable to the project or resource.

K.(10)(c) – overall cost-effectiveness evaluated at the portfolio level.

(c) Overall conservation cost-effectiveness must be evaluated at the portfolio level. Costs included in the portfolio level analysis include conservation-related administrative costs. For the additional cost-effectiveness tests identified in 10b -PSE must consult with the CRAG to determine when it is appropriate to evaluate measure and program level cost-effectiveness. All cost-effectiveness calculations will assume a Net-to-Gross ratio of 1.0, consistent with the Council's methodology.

B. Draft report comments and reviewer responses

This appendix contains comments on the draft final report and associated presentation, as provided by CRAG members and PSE. Also included under each section, as needed, are review team responses to the questions. These responses are in ***blue bold italic*** font.

Combined CRAG comments on SBW's draft final Third-Party Review of PSE's Electric 2010-2011 Savings report

[Issued April 27, 2012. Review team responses to comments are provided in bold, blue, italicized text underneath each comment.]

This document contains comments and questions related to SBW's draft final Third-Party Review of PSE's Electric 2010-2011 Savings report from interested Conservation Resource Advisory Group (CRAG) members. Unless specifically indicated, the below comments are extracted in their totality from individual emails received by PSE between April 24, 2012 and May 2, 2012. Comments are combined for ease of reference.

CRAG member commenting:

ICNU
NEEC
NWEC
Public Counsel

Industrial Customers of Northwest Utilities

ICNU supports the comments of the NEEC and NWEC regarding RCM savings. ICNU agrees that it is premature to reduce the RCM savings by such a large amount at this time.

Refer to the review team response to the NW Energy Coalition comments below.

Northwest Energy Efficiency Council

I concur with Danielle's views here on the RCM program. While this may be an oversimplification, the well-intended recommendation of the evaluators is to, in the name of precision, reduce the energy savings from this effort by an arbitrary percentage. This approach would seem inconsistent to me with the desired outcome of precision. A closer examination of the savings is likely warranted, but until that work is completed I don't support an arbitrary reduction of savings for this program.

Refer to the review team response to the NW Energy Coalition comments below.

NW Energy Coalition

Thank you for the opportunity to provide comments on the draft SBW/KEMA evaluation of PSE's 2010-2011 conservation program savings. Again, I congratulate PSE's Energy Efficiency Services team on a job well done in tracking, reporting and verifying savings!

The primary comment I have with regard to the draft report relates to the findings associated with PSE's RCM program. SBW/KEMA conducted a "detailed review" of the RCM program, but point out that this review "was not intended to be a formal impact evaluation that provided revised savings estimates within prescribed statistical significance limits." (at p. 36-7 of draft report) Yet during the webinar, the evaluation team recommended reducing 2010/11 claimed savings from the RCM program by 35%. (at p.

18 of ppt) I have to admit some discomfort with this recommendation. I understand this reflects best professional judgment of the evaluators, and I appreciate their effort to try to quantify a very complex set of factors. However, it seems that there are quite a number of unknowns here, and traditional impact evaluation is not well-suited to this type of program. A reduction of this magnitude feels premature, given uncertainties, limited data collection, and limited analysis.

The review team agrees that 35%, or some arbitrarily selected point between 0% and 35%, is at best a provisional final answer. There is a reasonable, albeit incomplete, analytical basis for the 35% estimate. The 35% calculated reduction we would suggest is not "arbitrary," in that it applies a standardized approach to pre- and post-implementation customer billing data, but rather is an effort to reduce the effect of some of the issues we found in the RCM program's approach.

Given the problems we found with PSE's RCM savings estimation methodology, we feel that some adjustment to the claimed savings is justified. Without one, the RCM claim will be in essence verified as providing 100% of the claim, primarily because a more precise answer is unavailable for some time. An appropriate reasonable value for this adjustment may lie between 0% and 35%. At this juncture, the correct adjustment is not known. Selecting a value depends on the policy lens through which one views the issue. A conservative approach, from the utility perspective, would be to assume that the utility claim is right unless there is overwhelming proof to the contrary, while a more aggressive approach would be to assume that the utility claim is wrong unless overwhelming proof of its correctness is provided. Still another approach would be to select some intermediate compromise value.

I agree with the recommendation to conduct a full evaluation of the RCM program that at a minimum addresses the various issues raised in this draft report -- that would (hopefully) allow time to delve into these issues and others that may be raised by CRAG members and determine the most effective form of impact evaluation. SBW/KEMA provided some additional helpful recommendations related to modifying key program elements.

The review team reiterates that it will be critical to carefully consider and develop a robust evaluation scope. The RCM program is a particularly difficult one to evaluate, especially from an impact standpoint.

Finally, I am relieved to hear that the RCM program continues to pass the TRC with flying colors, even with the adjustments recommended by the evaluation team, and that the recommended reduction in claimed savings would not impact PSE's ability to meet its 2010/2011 biennial savings target.

The revised final report provides more details of the effect that possible adjustments would have on the TRC. Even with a full 35% reduction, the 2010-11 RCM program would remain cost-effective.

Public Counsel

In general, our comments reflect the difficulties with the scope of this evaluation to examine the veracity of PSE's reported savings. In our view the comments of others, regarding the RCM findings, are also consistent with the challenges around the scope. Our hope is that, going forward, we can all learn from this experience to inform the scope and budget for the review for the next biennium. In our view a portfolio verification should include both a database review as well as field data collection (surveys, site visits) in order to develop realization rates. With a portfolio of PSE's size and complexity, it will likely be impossible to develop a realization rate for every measure. Nevertheless, there should be an opportunity to focus on those programs that are higher priority, in terms of energy savings and uncertainty of the savings. We echo a recommendation we've made previously: it would be beneficial for the CRAG (or subcommittee of interested CRAG members) to work with an EM&V expert to develop a scope of work for the next review. This would allow us all to have a common understanding of the objectives of the project, and how resources can be directed in the most efficient and effective manner.

In response to Public Counsel's general comments above, the review team discusses the scope of the verification effort, and realization rates, in separate sections below:

Scope of verification effort

The review team consisted of two well-respected firms with strong reputations in the EM&V field. Collectively, they have performed tens of millions of dollars of evaluation work for clients nationwide over the last two decades. The scope of these efforts has ranged from simple paper reviews to complex monitoring and modeling, across nearly all end uses and program types. Consequently, we understand deeply the tools available for, and the challenges of, assessing a complex efficiency portfolio.

That said, our professional opinion is that the scope of the 2010-11 portfolio review, as envisioned in the RFP and carried out over the past year, worked well. The effort was effective at assessing the veracity of the portfolio savings within the resources allotted. The nested approach balanced well the need for a comprehensive review with the desire to investigate areas of concern more deeply. The review team found a few areas of concern, and was able to highlight these and make recommendations for addressing them.

Nonetheless, as the example of the proposed RCM adjustment showed, this scope of work becomes more problematic when it is called upon to deliver justifications for defensible quantified adjustments to the program claims. The review team concurs with the suggestion that the CRAG, in conjunction with others, develops clear objectives and expectations for subsequent review rounds.

Realization rates

The essential conundrum in any quantitative assessment of portfolio energy savings is that an increase in savings certainty requires an increase in inspection/evaluation expenditures. A realization rate, as a term of art for energy program evaluators, implies a level of effort and rigor beyond the portfolio verification that was completed for 2010-11. To compare actual program-by-program realized savings to claimed savings in a defensible manner that justifies hard-and-fast adjustments generally requires some kind of impact evaluation, complete with samples that provide statistical significance. The required effort can be substantial. Based on current budget trends, we predict PSE may spend more than $6 million on portfolio-wide M&V efforts over the next four years. Even the relatively simple targeted on-site verification that the review team performed for this effort consumed about a third of the review budget.

In the case of deemed measures (or UES, unit energy savings), a binary approach (working/not working) may suffice in some instances, but even this is not necessarily clear-cut. UES values generally include some variation in expected savings, and thus they represent a mean value. Onsite inspections will highlight some of this variation. Just because a measure is not completely functional does not necessarily mean that the UES should be zeroed out for that project. The duct sealing deficiencies the

review team observed are a case in point. While we found four instances where the sealing was not optimal, they were yielding some savings, so the proper adjustment was not at all obvious.

Future reviews might consider leveraging the increased internal on-site inspection regimen now in place. Concurrent with the third-party review, PSE and KEMA have worked to implement internal programmatic M&V efforts that will dramatically increase the level and rigor of quality control inspections. PSE is now implementing a statistical sampling protocol for verification for the residential (REM) and Small Business Lighting (SBL) programs that will help PSE understand what is the true discrepancy/error rate of these measures associated with these programs.

Discrepancies found in File Reviews and Site Visits.

The Draft Report (e.g. p. ES-5) and the April 24, 2012 slide presentation mention discrepancies found in the file review that were described as "infrequent and minor." During the call it was confirmed that SBW/KEMA made no adjustments to PSE's reported savings as a result of these discrepancies. We have a few comments and questions on this topic.

a. Correcting savings claims for any discrepancies or errors identified during the review. Public Counsel's understanding is that if PSE becomes aware of any error, even those that might be considered 'infrequent and minor,' the Company's practice is to take all steps necessary to correct the error in their own tracking systems and in reporting with the UTC. We believe that is appropriate. It seems unusual that a verification review of reported savings would not make corrections for any discrepancies or errors that were discovered through either the file review and/or the site visits, even if they do not seem to be material. We agree with PSE's comments earlier, that these discrepancies should be included as an appendix and the reported savings should be adjusted.

The review team, per our understanding of the scope, focused on identifying systemic problems, rather than itemizing individual problems for the purpose of adjusting savings. The two minor systemic problems with duct sealing and one measure in Small Business Lighting program we identified through on-site verification are discussed more fully in the report in Section 2.3.2. The revised final report contains a listing of the 25 minor discrepancies uncovered during the targeted on-site reviews. Ten of these occurred at residential sites; the remaining 15 were business sites. In all cases, the review team concluded that these discrepancies were minor, and either individually or in aggregate did not materially affect the overall portfolio savings claim. Nonetheless, this list was sent to PSE for their review, so they could adjust their reported savings as appropriate. This listing is can be found in Appendix G.

b. Table 12 Comments Re: Duct Sealing and Small Business Lighting Site Visit Results. This Table includes comments regarding findings on these two programs. The comments for duct sealing are as follows: "Inspected 9 homes that received the duct sealing measure. 4 received an inadequate job of duct sealing and should not have received the full deemed savings for this measure." The comments related to small business lighting indicate that 2 of 8 sites had errors in the documentation that "doubles the claimed savings for the measure."

During the call last week SBW/KEMA indicated there was no adjustment for this finding. As described above, we believe that some adjustment, even for the 4 duct sealing measures and 2 small business lighting measures, would be appropriate.

Refer to preceding comments.

A larger issue, though, is what further action, if any, was taken by SBW/KEMA to further examine these issues. As described in the report, the comments seem somewhat significant. If 44% of the duct sealing sample were installed adequately, that would appear to suggest it might be worth looking into this further. Was this one contractor, multiple contractors? If we examine more, do we find similar results? Similarly, if there were errors on 25% of the small business lighting sample, that too suggests a closer look is warranted. Was there any additional review conducted by SBW/KEMA? If the scope didn't allow for this, are there recommendations for further QC/verification that PSE should undertake?

Throughout the process, both during the initial review and detailed reviews, the review team was continually reviewing what it was finding, and assessing whether closer scrutiny was warranted. The professional judgment that the team brought to bear was a critical element of the triage process, determining which discrepancies and issues were likely significant, and which were likely not so. Our early sense of significant issues informed our recommendations for areas for detailed review. Likewise, we began the targeted on-site reviews carefully watching to see if significant issues would arise from our field observations. When surveyors found problems, the review team assessed whether a pattern was emerging, or whether instead this was likely an infrequent occurrence. We updated their assessments as additional data points became available. While we were expecting to find areas that warranted a closer look, we did not, and the duct sealing and lighting issues we did describe were very minor components of much larger projects in a wide-ranging program portfolio. The revised final report attempts to make this point more clearly, and also recommends that PSE investigate these issues further.

SBW/KEMA indicate that the sample size was not significant to allow for the development of a realization rate. We recommend that the final report discuss this issue more fully. Our understanding is that more commonly, a portfolio verification would include sufficient field data collection to determine a realization rate (within a certain sampling precision and confidence). While that was not part of this scope, we thought that if issues were identified during the site visits, that would lead to further analysis and examination. It's difficult to know how to interpret or learn from the comments mentioned above. For example, if there were 400 duct sealing projects, is there a possibility that 44% of those (176) were performed inadequately? The same could be said for the small business lighting findings. It would be helpful if the final report could put these in a broader context.

Refer to preceding comments.

1. *RCM*. In our view the discussions and comments regarding the RCM program highlight the underlying challenge of the scope of this verification and review. We agree with comments of PSE and others that there needs to be more comprehensive discussion and explanation for the adjustment to savings, and why the amount is appropriate. We understand that SBW/KEMA was not conducting an impact evaluation. Rather, this review was in the context of the verification of the reported savings. It seems clear from the discussion that there are some areas of concern regarding the reported savings. For example, the report notes, "In 20% of the

sample, we were unable to determine the source of the final savings estimates" (p. 44) The report also notes that the practice of excluding projects with negative savings "biases the overall savings upwards." (p. 46, savings would be reduced 20% if these projects were not excluded). They note the marked contrast in documentation and analytical rigor between a large BEM project and an RCM project of similar scale (pp. 44-45). It's also clear from the discussion that the RCM program is achieving some very positive results. The program would very likely benefit substantially from an impact and process evaluation.

Regarding the first point about the challenges of RCM verification, the review team's previous responses have discussed the pros and cons of adjusting the claimed savings using the analysis performed. As for subsequent points about areas of concern and the benefits of formal evaluations, we concur that a full evaluation will help flesh out some of the issues we uncovered, and may also provide answers to the questions raised. Lastly, the review team certainly agrees that the RCM program is worthwhile in many ways, and hopes that subsequent programmatic changes will make it even better.

2. *Verification of Third-Party Administered Programs.* The final draft report seemed to have some mixed or conflicting discussion of this issue. Table 17 includes an * comment, noting that for some programs there was no evidence that the verifications were conducted randomly. That sounds fairly significant, but wasn't explored or discussed very much, and it does not appear to be consistent with best practices for verification. The recommendations section did not appear to discuss this (but if we missed something, please do let us know.)

   The review team revised the report to clarify that no information was provided by the programs on how projects are selected (random or not random) and to state that best practices suggest random inspections. We also revised the recommendations to state that random verifications should be considered on a program-level basis.

3. *Showerheads (holiday outreach)*. Public Counsel notes that while the showerhead savings of 4,389MWh for the biennium were verified at 100% (p. ES-8), of that total 2,787 MWh of these savings came from the Holiday Outreach Program (p.14) which took place in the final two months of the biennium.

   Although the Holiday Outreach Program savings of 2,787 MWh are included in the review team's verification of the total claimed savings for the showerhead program, they were left out of the Database Savings in Table 7 as there were no "program tracking" records available for these measures and thus they were not included in our database or evaluation sample. Based on the evidence we obtained, the review team concluded that they are a valid savings claim, though as discussed in the subsequent point, questions remain about the proper value for the unit energy savings.

4. Because the showerhead program uses RTF savings estimates that already take into account installation estimate, the SBW/KEMA report did not take a closer look at the savings associated with this program. However, because the distribution method for the Holiday Outreach program differed from any of the methods contemplated by the RTF, the savings estimate used for the holiday outreach may not accurately capture the results for this particular distribution. Specifically, Public Counsel is interested to learn more about whether the installation rate in the RTF estimate used for the holiday outreach is applicable for this means of distribution. It is

understandable that the report did not highlight this program for a deeper look, because at the time the evaluation plan was developed PSE was only distributing showerheads by methods considered by the RTF (these include Mail-By-Request, Retail, and Direct Install). However, since the nature of the showerhead program changed late in the biennium, and the bulk of the savings (for both gas and electric) came from this one program in a short period of time, Public Counsel believes that these savings deserve a closer evaluation.

The review team feels this is a well-made point and further study of the utilization, and thus savings, of showerheads provided at give-away events should be conducted. In order to determine the installation rate of give-away showerheads, PSE would have to record and track customer information and perform follow up site visits or phone calls. We have edited the final report to include these suggestions.

Puget Sound Energy

In addition to some minor editorial comments already provided to SBW, PSE has more general comments as follows:

1. Summary tables and graphs should include PSE's 2-year savings target of 622,000 MWh as a point of comparison.

   The final report was revised to provide these.

2. The 2,787 MWh of showerhead giveaway savings that was not included in the original batch of tracking data given to SBW caused some confusion. It was not really a discrepancy between reported and reviewed savings, but was simply some missing tracking data that was subsequently provided. This should either be omitted from the final report, as it was not really a discrepancy, or at least explained much more clearly to avoid confusing the reader.

   The revised final report clarifies this issue.

3. A listing of the small discrepancies identified during the targeted on-site verification should be included as an appendix. The report should include language to the effect that while SBW did not find these discrepancies to be reflective of larger systemic issues and that the impact on total portfolio savings was negligible, a list of the discrepancies was nevertheless compiled and sent to PSE for review and to adjust their reported savings as appropriate.

   This listing is now contained in Appendix G.

4. The Company is concerned that the proposed adjustment to savings for the RCM program is based on insufficient information to estimate a number with reasonable accuracy. We recognize the challenges faced by SBW and that a full impact evaluation is beyond the scope of this study. The recommendation to conduct a formal program evaluation is a valid one. To the extent that SBW feels compelled to provide an estimated savings adjustment for RCM, PSE asks that the report include a thorough explanation of how the adjustment was derived and recognition that the estimate is very uncertain and subject to a number of assumptions and caveats, which are identified in the report.

The revised final report provides more caveats and qualifications, as well as explanations and supporting data, to permit the reader to obtain a fuller understanding of the basis for the calculated reduction. The review team is comfortable with the final savings adjustment, if any, differing from our calculation, as we well recognize its inherent uncertainties.

That said, we also feel some kind of adjustment is warranted, given the findings. Without one, a questionable RCM claim will be in essence verified as providing 100% of the claim, mainly because a more precise answer will not be available for at least a year until the future impact evaluation is completed.

C. C/I Retrofit evaluation report

This appendix contains the final report for the Commercial/Industrial Retrofit Evaluation. It documents the impact evaluation of 42 commercial/industrial projects as part of the impact evaluation. These projects were carefully inspected and analyzed by the third-party evaluator during the timeframe of our study. Consequently, we felt justified in including these evaluation results in our overall count of verified projects.

C&I Energy Efficiency Retrofit Custom Programs Portfolio Evaluation

Contents:

- C&I Energy Efficiency Retrofit Custom Programs Evaluation
- Evaluation Report Response

This document contains both the final **Commercial and Industrial Energy Efficiency Retrofit Custom Programs Evaluation Report** and the Puget Sound Energy **Evaluation Report Response** (ERR). PSE program managers prepare an ERR upon completion of an evaluation of their program. The ERR addresses and documents pertinent adjustments in program metrics or processes subsequent to the evaluation.

NAVIGANT

COMMERCIAL AND INDUSTRIAL ENERGY EFFICIENCY RETROFIT CUSTOM PROGRAMS PORTFOLIO EVALUATION

Final Report

Prepared for:
Puget Sound Energy

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Table of Contents

Executive Summary

This report describes the market, process, and impact evaluation activities related to PSE's four C&I Program Schedules:

1.) Schedule E250: Commercial/Industrial Electric Retrofit Program
2.) Schedule G205: Commercial/Industrial Gas Retrofit Program
3.) Schedule E258: Large Power User Self-Directed Program
4.) Schedule E257: LED Traffic Signals

Evaluation findings serve to inform Program Schedule improvements anticipated for the 2012-2013 program cycle while also complying with the Washington Utilities and Transportation Commission (WUTC) filing requirements. This report presents the evaluation tasks completed and the corresponding final evaluation findings.

ES Market Evaluation

The market evaluation focused on four priority sectors: hospitals, food processing, the public sector, and offices. Research efforts relied on two parallel efforts: (1) an End User Assessment, through which the team collected data from building occupants to assess opportunities for further energy efficiency retrofits and (2) a Supply Chain Assessment, through which the team conducted in-depth interviews with a variety of market actors to understand the dynamics of the market at a higher level. The project team also conducted in-depth interviews with PSE customers eligible to participate in Schedule 258 and with market actors related to Schedule 257.

Key Findings for Schedules G205/E250

Figure ES 1 summarizes the key findings from the four priority sectors. Additional detail is provided in the accompanying text.

Hospitals represent the strongest opportunity for energy efficiency upgrades among the four sectors identified because of the economies of scale and favorable investment conditions. They **universally own and occupy** their facilities, and their large facilities provide fertile ground for identifying bundles of measures at one facility. Nearly 90 percent of hospitals have plans to invest capital in their facilities in the next two years, which implies that funds may be available for energy efficiency.

Some of the key strategies that PSE may consider leveraging for the hospital sector include the following:

- » Achieve deeper penetration of energy efficiency by targeting the **concentrated ownership** in the hospital sector.
- » Leverage previous efforts at NEEA and existing industry partnerships, including **strategic energy management plans.**
- » Consider technology-specific opportunities: air conditioning units (specifically central chillers), on-site data centers, and retrofits to replace or add fluorescent lighting.

The food processing sector is poised for further engagement with PSE. This is a high-potential market because the **industry itself is creating the demand** for additional energy efficiency investment. The sector's energy use intensity reduction goals create the point of entry for PSE, and individual firms' strategic energy management plans create key starting points for discussion. More than half of food processors report having participated in PSE programs in the past, providing a strong foundation for soliciting deeper participation in the future. PSE's outreach efforts may focus on approaches to achieving the goal at the industry level as well as those goals established by individual firms.

Some of the key strategies that PSE may consider leveraging for the food processing sector include the following:

» Consider whole-building approaches to reach the variety of technology opportunities identified in this sector: lighting (including use of LEDs), food-processing specific technologies (especially process refrigeration/freezing and materials handling/conveyor motors).
» Engage more deeply with the Northwest Food Processing Association, which represents about one-quarter of the food processing facilities in the region; consider joining as a Supplier Member.
» Work with trade allies to develop strategies to address the seasonal nature of the industry and its effects on investment decision making.

The public sector represents a possible target for additional targeting for PSE but not the strongest of those explored for this project. The dynamics differ at the state and local levels. More state government agencies (54 percent) report the intention to invest capital in their facilities in the next two years than local governments (28 percent). Local governments (96 percent) report higher levels of owner occupancy than state governments (29 percent).

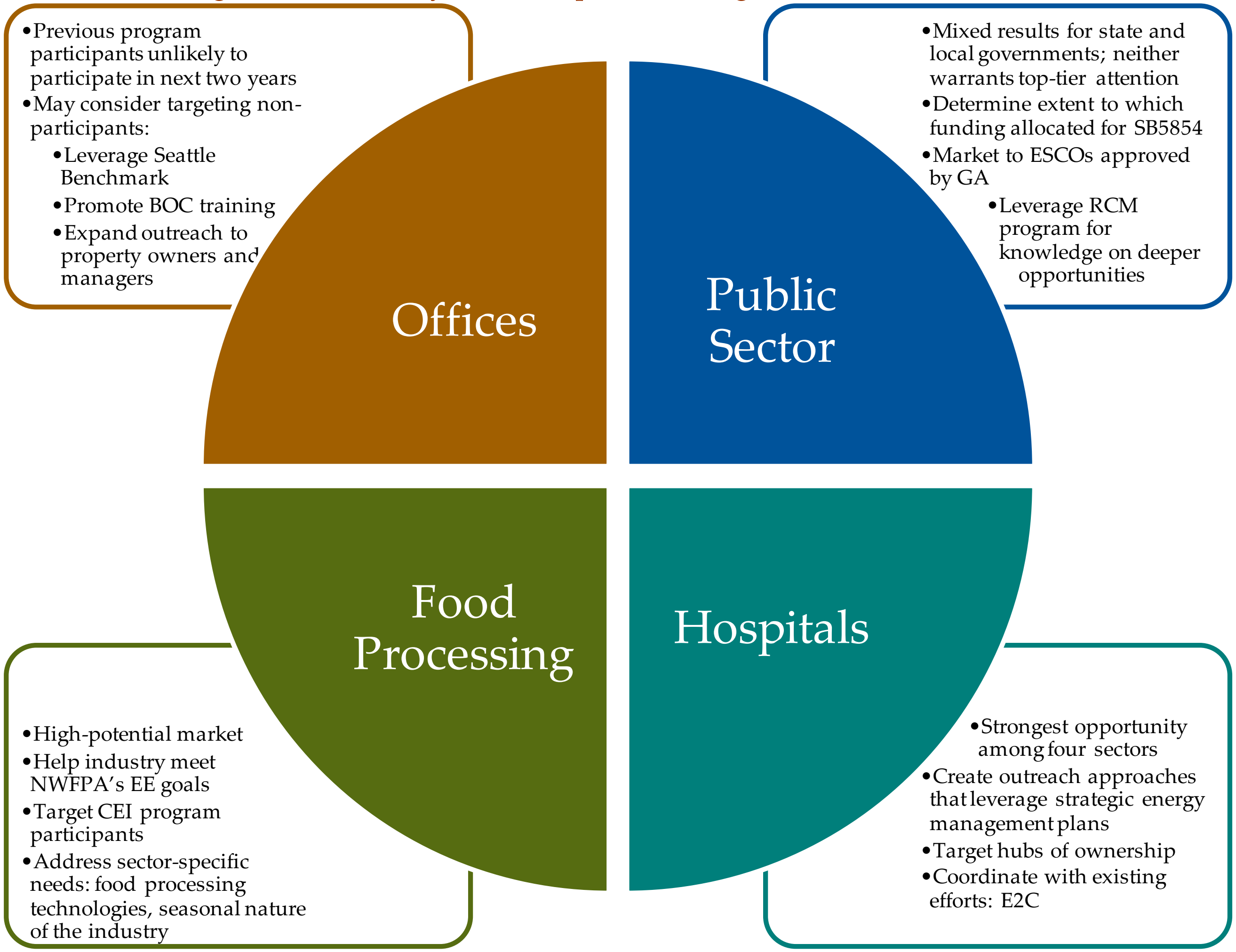
If PSE decides to target this sector at all, it may consider the following strategies:

» Segment efforts to reach this sector into those that reach the state government agencies and those that reach local government agencies.
» Determine the extent to which SB 5854 was funded in the 2011-13 capital and operating budgets.
» Leverage existing expertise about these segments, including that held by ESCOs already approved by the Department of General Administration and by participants in PSE's Resource Conservation Manager Program.

Previous participants in PSE's incentive programs from the **office segment** represent the weakest segment of the four investigated for additional targeting by PSE. This segment is challenged economically, with only half of the facilities planning to invest capital in the next two years. They report very narrow bands of remaining opportunity for energy efficiency, with only controls reported by more than 10 percent of respondents as a remaining opportunity. While this segment does have high levels of owner occupancy and substantial facility size, the ownership's receptivity to additional investment overshadows those favorable factors.

PSE may consider further investigation of the market for offices that have not previously participated in PSE programs. Although their capital investment plans may mirror their participating counterparts, more energy efficiency retrofit opportunities likely exist. In the event that PSE chooses to pursue non-participating office customers, much of the market assessment work conducted for this project can be applied. PSE can leverage the efforts that other market actors have already initiated to deepen penetration of energy efficiency in the offices sector. These efforts include the City of Seattle's benchmark, building Operator Certification (BOC) training offered by NEEC and IBOA, and the development of relationships with industry associations and building owners that NEEA has fostered in the past decade.

Figure ES 1. Summary of Sector-Specific Findings from Market Evaluation



Source: Navigant analysis 2011.

Key Findings for Schedule 257

PSE may consider sunsetting the Schedule 257 offerings due to market saturation and free-ridership issues. Interview findings indicate this market may be transformed. Transportation agencies have already replaced all the old traffic light signals that could be replaced. Further, the role of a utility incentive is minor or ancillary to the decision to replace traffic lights. Replacements make economic sense without the utility incentive due to cost savings in three areas: energy, operating, and maintenance cost savings.

Key Findings for Schedule 258

There is still significant, though diminishing, savings potential among most end uses for Schedule 258 customers. The next tier of savings opportunities is more expensive, and the payback is longer. Major opportunities include retrocommissioning at facilities that condition the majority of their space; installing variable frequency drives in process applications; and considering controls for lights, conversion of high-bay HID lamps to fluorescent, and LEDs for exterior lighting. Some additional opportunities are present at one or two customer sites; these additional details are discussed in the main report.

ES Process Evaluation

Navigant conducted the process evaluation for PSE's Custom Retrofit programs using six analytical components to triangulate key findings: program management interviews, logic model development, customer surveys and in-depth interviews, trade ally interviews, program and customer data-mining and utility program benchmarking. Findings were distilled into overarching findings and findings specific to individual programs including the Custom Grant, EnergySmart Grocer (ESG), Building Energy Optimization (BEOP), Large Power User and LED Traffic Signals programs.

Key Program Findings

PSE's custom retrofit programs are generating considerable energy savings – both through the programs and through spillover, and customer feedback on its longer-running custom programs is quite positive. PSE's programs have penetrated very effectively its largest customers over the past two years while making some inroads among its smaller C&I customers as well. Nonetheless, PSE appears to have a number of opportunities to enhance the efficiency and effectiveness of its custom retrofit programs, particularly its *Schedule E250 programs* – Electric Custom Grant, ESG and BEOP.

Electric program benchmarking suggests that PSE spends more (as a percent of C&I revenue) on its **electric program portfolio** and **electric Custom Grant program** and they cost more (per first year kWh saved) than other regional utilities' (with the possible exception of Seattle City Light for which data is not available at that level) and national best practice utilities. The high concentration of custom program activity in PSE's most active trade allies also suggests that there are opportunities to further leverage the balance of less active trade allies. While a significant percentage of PSE's program cost is incentives, these high incentives are not driving the high savings levels achieved by other programs which are offering lower incentives. PSE’s savings rates (savings as a percent of total C&I consumption) are at about the median level and can similarly be improved.

In contrast, PSE’s **Schedule 205 Custom Gas program** is a top performer regionally in 2009 based on Navigant’s benchmarking in spite of its low rate of savings relative to its companion electric program. Navigant’s PSE gas data mining indicates that considerable savings opportunities remain and that large customer opportunities are likely to be most notable in the real estate/leasing and other services (except public administration) sectors.

Navigant’s evaluation of PSE’s other individual programs’ performance revealed a wide range of variability:

- The **ESG program** has obtained deeper savings than PSE’s other programs, but its results compared to Avista’s Smart Grocer program suggests there may be considerable remaining savings opportunity in new construction and non-refrigeration measures.
- **BEOP** is clearly a program in an early stage with tremendous potential, and the program structure should continue to be reviewed critically to be sure this potential is realized.
- The **LED Traffic Signals** *program* is a very low cost source of limited savings, but may very well merit discontinuation if the market has been transformed.
- The Schedule 258 **Large Power User Self Direct** *program* is notable for its positive customer feedback and relatively large projects that commanded lower incentives per kWh saved than custom grant projects (excluding BEOP and ESG.)

Recommendations

Navigant recommends that PSE undertake the following nine steps to enhance the efficiency and effectiveness of its C&I custom retrofit programs:

- ***Recommendation 1***. Navigant recommends that PSE **consider applying the Large Power User program concept** of “customer’s own funding available to be used or lost” to increase participation of larger Schedule 250 customers.
- ***Recommendation 2***. Navigant recommends that PSE **continue to focus resources on optimizing** its new (Schedule 205, 250, and, ultimately, 258) **BEOP structure** per TA, Customer and best practices findings.
- ***Recommendation 3***. PSE should **assess the potential benefits of reallocating resources from Schedule 205 and 250 custom grant program incentives to TA and customer support and outreach.**

- *Recommendation 4*. Navigant recommends that PSE assess the potential for **leveraging the success of its ESG program**, both through replicating its structure as feasible and better leveraging PECI's presence at grocers.
- *Recommendation 5*. Navigant recommends that PSE explore **opportunities to increase Custom Grant program efficiency** and reduce application processing time.
- *Recommendation 6*. PSE should review the potential to better **utilize its many customer touch points** to market its EE programs.
- ***Recommendation 7.*** Navigant recommends that PSE **continue to invest in enhancing its marketing materials and approach around market segments.**
- *Recommendation 8*. Navigant recommends that PSE confirm and then develop specific strategies and tactics to address its **target market segments**, leveraging related findings from Navigant's market assessment.
- ***Recommendation 9.*** PSE should ensure that its new **program tracking system** provides the functionality required for future program delivery.

ES Impact Evaluation

The Impact Evaluation aimed to develop measure-, program-, and schedule-level realization rates for the G205, E250, and E258 Commercial/Industrial Retrofit Schedules. Findings from the Impact Evaluation provide PSE staff with the feedback they need to increase program efficacy and to advance the research and policy objectives of PSE staff and the Conservation Resource Advisory Group (CRAG) by providing independent review of program schedule achievements.

The Impact Evaluation found PSE's Commercial/Industrial Retrofit Schedules to be **exceeding** savings targets due to *conservative* and *astute ex ante* project analyses. Table ES 1 provides an overview of the realization rates for each Program Schedule evaluated through this study. A more thorough discussion defining the Impact Evaluation strategies along with each realization rate category is provided below:

Table ES 1. Summary of Program Schedule Realization Rates

Program Schedule	*As Installed* Realization Rate	*As Evaluated* Realization Rate	*Economically Adjusted* Realization Rate
E250 & E258	99.3%	102.3%	105.9%
G205	99.9%	100.3%	102.4%

Overall, the Impact Evaluation of PSE's 2009-2010 C&I Program Schedules aimed to characterize Program Schedule specific energy and demand impacts for commercial and industrial retrofit measures, including:

» Quantifying the impacts of all retrofit measures and activities on annual gross energy consumption while accounting for any interactions among technologies.

» Establishing post-implementation performance profiles for installed measures and activities.

» Explaining discrepancies between the results of this study and the *ex ante* savings estimates.

Evaluation metrics and parameters reported through this study include:

» Gross program savings estimates and realizations rates, by fuel type (i.e., kWh and Therms), for retrofit projects.

» Energy usage profiles for C&I technologies metered through on-site Measurement & Verification (M&V) activities.

Navigant adopted a Stratified Ratio Estimation on-site Measurement & Verification (M&V) sampling framework to achieve 90/10 confidence/precision for the evaluation of PSE's *Program Schedule-level* realization rates. Under this approach, Navigant divided the sample population into subgroups (i.e., strata) and selected sample units equal to the portion of the population in each strata. This strategy ensured that Navigant evaluated the largest contributors to program performance, while also addressing a sufficient number of smaller projects that, in aggregate, could represent a substantial percentage of *ex ante* savings. The final sampling framework achieved 90/10 confidence and precision across lighting technologies, 80/20 across the remaining electric technologies, and 80/15 across the gas technologies offered through Schedule G205.

Table ES 2 provides an overview of the Impact Evaluation realization rates for each of the three Program Schedules included through this study:

Table ES 2. Summary of *As Evaluated* Program Schedule Realization Rates (PY 2009 – 2010)

Program Schedule	Program Spending	Ex Ante Savings	Ex Post Savings	Realization Rate
E250 & E258	$39,954,232	152,247 MWh	155,749 MWh	102.3%
G205	$3,864,784	1,424,472 Therms	1,428,745 Therms	100.3%

It should be noted that the realization rates provided in Table ES 2 reflect the difference between expected savings at the time of installation and verified savings more than one year after project completion (*As Evaluated)*. And throughout the evaluation, Navigant observed that many participants altered their operating profiles between this timeframe for a myriad of reasons outside the realm of program influence, including:

» **Idiosyncratic Factors** – changes in equipment usage and operating patterns that are unique to a participant's financial health, employee attrition, and corresponding production schedules.

» **Economic Factors** – changes in equipment usage and operating patterns as a result of shifts in industry and economic climates.

The Impact Evaluation explored each of these non-programmatic factors while quantifying their impact on project-/program-level realization rates. Navigant distinguished the impacts from each of these factors through discussions with facility personnel and in-depth file reviews to calibrate responses.

Table ES 3 provides an overview of program schedule realization rates when removing the influence of *idiosyncratic factors* on project level savings. This was accomplished by carefully reviewing the documentation on evaluated projects and comparing the pre-installation assumptions used to develop *ex ante* savings estimates to the *ex post* observations and feedback from facility personnel. In addition to the project input assumptions, Navigant also reviewed the *ex ante* calculation methodologies against industry standards and accepted engineering practices. Finally, Navigant collaborated with PSE to ensure that all available information collected during the participation process was properly accounted for in the *ex post* savings analyses.

Collectively, this information was used to reconstruct the project planning/pre-installation conditions along with the corresponding savings that would have been achieved upon project completion (*As Installed Realization Rate)*. The realization rate metric at this particular point in the program cycle is a significant milestone and of key interest from a stakeholder perspective which warranted this additional level of investigation.

Table ES 3. Summary of *As Installed* Program Schedule Realization Rates

Program Schedule	Program Spending	Ex Ante Savings	Ex Post Savings	Realization Rate
E250 & E258	$39,954,232	152,247 MWh	151,181 MWh	99.3%
G205	$3,864,784	1,424,472 Therms	1,423,047 Therms	99.9%

The *As Installed* realization rates provided in Table ES 3 are **conservative**; the realization rates at the point of installation is an instantaneous metric that cannot account for variability in weather patterns and productions schedules which inevitably drive project performance over time. Accordingly, the *As Installed* realization rates only capture overestimates in the *ex ante* savings methodologies, of which PSE's C&I Program Schedules had limited instances of:

» NCI ID #26: The *ex ante* analysis leveraged Regional Technical Forum (RTF) values to calculate refrigeration project savings. Navigant accepted this analysis and assigned an *As Installed* realization rate of 100% to this project. However, the *As Evaluated* realization rate was calculated to be 133%; similar to the realization rates found from a BPA impact study of the Energy Smart Grocer Program from several years ago. In this case, the *As Installed* realization rate was lower than what was actually achieved.

» NCI ID #43: This project involved two pump retrofits at one facility, only one retrofit of which was evaluated. Discussions with facility personnel revealed an overestimate in pump operating hours resulting in an *As Installed* realization rate of 31%. However, the second pump retrofit (not included in the Impact Evaluation sample), achieved a 111% realization rate, resulting in a 71% realization rate for the facility

» NCI ID # 64: This project involved the installation of insulation at a participant facility. The *As Evaluated* realization rate was 94% due to the addition of ceiling fans which were not present at the time of installation. Through discussions with PSE, Navigant recognized that in some cases, ceiling fans actually increase convective heat loss through the roof. In the absence of the ceiling fans, the *As Installed* realization rate was actually 100%.

Section 4.3.1 Idiosyncratic Factors (As Installed Realization Rates) provides additional project level detail influencing the *As Installed* realization rates. The *As Installed* realization rates provide insight into the accuracy of the calculations used to forecast savings in the absence of post-installation data. The results of this effort clearly indicate that PSE's EME's are applying mathematically astute methods to the *ex ante* analyses that are consistent with industry standards and accurately predict *ex post* savings estimates.

The C&I sector is particularly sensitive to economic changes because production throughput, occupancy, and operating schedules are driven by customer demand. Similarly, the changes in equipment usage also affect the efficiency of the baseline and replacement technologies incented through PSE's Program Schedules. Throughout the Impact Evaluation, Navigant encountered a number of participant sites affected by these *economic factors*; a majority of which realized lower than expected *ex post* savings estimates. The subsequent impact of these economic-driven changes on project-/program-level realization rates compound over time because savings estimates apply across a measure lifetime of several years. As such, Navigant recognized the importance of disaggregating the effects of these factors when assessing program performance and developed a robust method that accounted for variations in operating conditions attributed to external economic activity.

For temporary changes in the participant production schedule, Navigant calculated *Economically Adjusted* savings using two consistent baselines:

1.) *Full Production (Ex Ante) Baseline Operating Schedule:* Both pre- and post-installation energy consumption was calculated using the production schedule observed at the time of participation (i.e., full production schedule). Full-production adjusted operating schedules were derived from a comprehensive review of historic production logs relative to current operating schedules.

Current Production (Ex Post) Baseline Operating Schedule: Both pre- and post-installation energy consumption was calculated using the production schedule during the on-site M&V process (i.e., current current production schedule).

Table ES 4 provides an overview of program schedule realization rates when removing the influence of economic factors on project-level realization rates.

Table ES 4. Summary of *Economically Adjusted* Program Schedule Realization Rates

Program Schedule	Program Spending	Ex Ante Savings	Ex Post Savings	Realization Rate
E250 & E258	$39,954,232	152,247 MWh	161,230 MWh	105.9%
G205	$3,864,784	1,424,472 Therms	1,428,745 Therms	102.4%

Examples of the economic factors affecting program realization rates, included:

- **Change in Production Schedules**
  - NCI ID #21: This project involved the installation of compressor upgrades at a manufacturing site. Although the *As Evaluated* realization rate was 99%, the facility actually increased their production requirements by consolidating all production into one line as a result of the economic downturn. This increased the load on the compressor, resulting in lower savings. The *Economically Adjusted* realization rate for this project was 109%.
- **Idled Equipment (Temporary Shutdown):**
  - NCI ID #65 and NCI ID #66: This project installed fume hood retrofits at a participant lab. As a result of the economic recession, a majority of the fume hoods are now idle with future occupancy (and usage) expectations. The *As Evaluated* realization rates were 70%, but the *As Installed* and *Economically Adjusted* realization rates were both 100%.
  - NCI ID #5: This project involved the chiller upgrades at a large facility. As a result of the economic downturn, the facility has since closed but is expected to re-open. And though the *As Evaluated* realization rate is 0%, both the *As Installed* and *Economically Adjusted* realization rates were 100%.
- **Site Closure (Permanent Shutdown):**
  - NCI ID #29: This facility installed refrigeration upgrades but as a result of the economic downturn, is permanently closed. Even though the *As Evaluated* realization rate was 0%, Navigant confirmed that the *As Installed* and *Economically Adjusted* realization rates were 100%.

Section 4.3.2 Economic Factors (Economically Adjusted Realization Rates) provides additional detail on the rationale used to identify and account for the economic impacts on Program Schedule realization rates. Navigant recognized that economic volatility occurs periodically, and it is no more valid to choose an "up cycle" than a "down cycle" when evaluating Program Schedule performance. By providing a clear distinction between programmatic and non-programmatic factors affecting the realization rate, future evaluation results will ensure a fair assessment of Program Schedule performance over the EUL of incented measures.

Overall, the Impact Evaluation found PSE's C&I Program Schedules to accurately forecast and assess realized savings. And evaluation experience obtained through this effort revealed the following opportunities to continue **exceeding** performance goals in future Program cycles:

- ***Recommendation 1***. **Standardize** Participant Data Requirements
- ***Recommendation 2***. Request Participants with Energy Management Systems **Provide Pre-/Post-Trend Data**
- ***Recommendation 3***. **Normalize Program Schedule Tracking Databases** to Enhance Reporting and Evaluation Integrity
- ***Recommendation 4***. **Continue to Incorporate an Economic Analysis Component** for Future Evaluations

1 Introduction

This report describes the market, process, and impact evaluation activities related to PSE's four C&I Program Schedules:

1.) Schedule E250: Commercial/Industrial Electric Retrofit Program
2.) Schedule G205: Commercial/Industrial Gas Retrofit Program
3.) Schedule E258: Large Power User Self-Directed Program
4.) Schedule E257: LED Traffic Signals

Evaluation findings serve to inform Program Schedule improvements anticipated for the 2012-2013 program cycle while also complying with the Washington Utilities and Transportation Commission (WUTC) filing requirements. This report presents the evaluation tasks completed and the corresponding final evaluation findings.

1.1 Scope of the Evaluation

Market Evaluation: The Market Evaluation addressed the following key research questions:

» How is the commercial & industrial EE market structured?

» Which market segments are ripe for future programs?

» How are the major trends shaping the market?

In addition to addressing the research questions, the report enumerates specific opportunities for PSE's intervention in the marketplace. The team seeks to make recommendations actionable for PSE staff, using the analysis from the data collection efforts as justification for the recommendations. This data-driven approach will provide PSE with the information needed to enhance program design with confidence that the adjustments will improve overall program performance.

***Process Evaluation*:** The Process Evaluation identified opportunities to improve the efficiency and cost effectiveness of PSE's C&I Program Schedules by:

» Documenting current program design and operations.

» Identifying and recommending program improvements that will result in more energy savings, better cost-effectiveness and high participant satisfaction.

The evaluation team will analyze process data to triangulate between participant and non-participant survey responses to process questions, PSE staff and implementer in-depth interviews, trade ally interviews, and program material review to identify the most defensible conclusions and recommendations

Impact Evaluation: The impact evaluation addressed the following research objectives to quantify savings across each of PSE's C&I Program Schedules:

- » A thorough review of existing tracking systems, secondary literature, and Best Practices literature to guide the development of the Impact Evaluation framework.
- » Develop a 90/10 confidence/precision sampling framework using a stratified ratio estimator approach to estimate *Program Schedule-, program-, and measure-level* realization rates.[1]
- » Develop performance profiles for measure technologies metered through this effort.
- » Quantify Non-Energy Benefits (NEB) and verify input assumptions through a combination of staff surveys, secondary research, and engineering analyses.
- » Compile Impact Evaluation findings and recommendations that will continue to improve the energy savings performance of future Program Schedules.

1.2 Organization of Report

This report is organized into three sections, as follows

- » Market Evaluation
  - o Methodology
  - o Preliminary Findings
  - o Preliminary Opportunities for PSE Involvement
- » Process Evaluation
  - o Methodology
  - o Customer Database
  - o Preliminary Findings
  - o Conclusions
- » Impact Evaluation
  - o Methodology
  - o Evaluation Results
  - o Factors Influencing Evaluated Realization Rates
  - o Validity & Reliability of M&V Findings
  - o Impact Evaluation Conclusions and Recommendations

[1] This is consistent with the statistical accuracy of evaluations in other jurisdictions and corresponds with an Enhanced Level of Rigor stipulated in the California Energy Efficiency Evaluation Protocols.

2 Market Evaluation

The analysis in this section provides the broad market context in which PSE DSM programs exist, and thus frames the data presented in the remaining sections of the report. The Market Evaluation considers how PSE interacts with other entities in the market for energy efficiency in commercial and industrial (C&I) energy efficiency opportunities and how those entities interact with one another. These relationships serve as the foundation for market interventions and influence the approaches that PSE takes to achieve the energy efficiency results that it seeks.

The Market Evaluation provides information that PSE can use to enhance its C&I energy efficiency retrofit programs' ability to influence the related markets for energy efficiency. PSE has already developed knowledge about many parts of the market for C&I energy efficiency opportunities through its planning and implementation of existing programs and its interaction with other market actors. The results of this Market Evaluation supplement that information and will help to inform PSE's future program design, especially in terms of marketing strategy.

Table 2-1 summarizes the key research questions addressed by the Market Evaluation. It specifies the location of the discussion surrounding each research question in this report.

Table 2-1. Key Research Questions

Topic Area	Research Questions	Report Location
How is the market structured?	» Who are the major market actors? » How are customers and market actors distributed geographically? » How do products and value flow through the market? » What are the primary sales strategies used by major market actors to promote energy efficiency products and services?	Section 2.2.1
How are the major trends shaping the market?	» Which market forces are the key drivers and barriers to adopting energy efficiency? » How has the economic downturn affected opportunities for financing energy efficiency projects? » What are the effects of changes in codes and standards? » Which high-impact technologies, products, and services will affect the market in the next 2-5 years?	Section 2.2.2
Which market segments are ripe for future programs?	» To what extent are PSE's priority sectors poised for deeper penetration of energy efficiency? » To what extent do energy efficiency project opportunities remain among 258 customers? » How can PSE leverage existing trends in priority sectors to achieve more energy efficiency savings in these sectors?	Section 2.2.3

2.1 *Methodology*

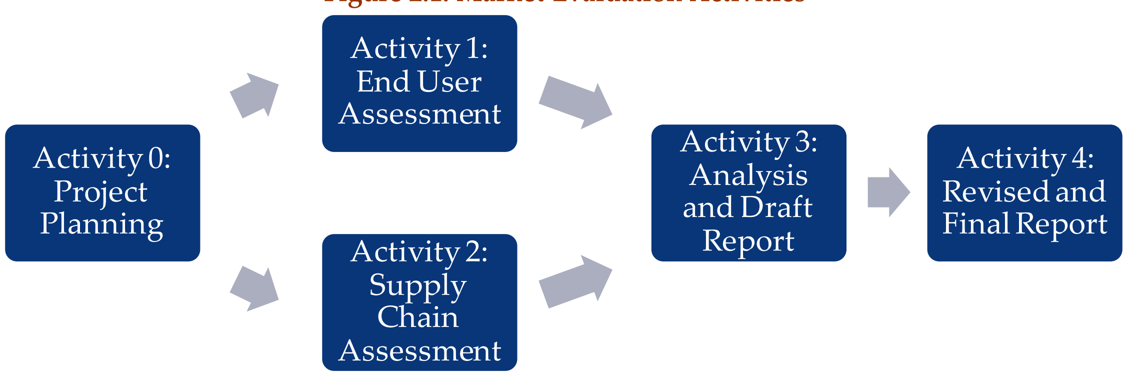
The Market Evaluation relied on two key data collection activities, which the evaluation team conducted in parallel as seen in Figure 2.1. The End User Assessment combines secondary research and a survey with targeted end users to create a view of the market for energy efficiency among C&I customers in priority sectors. The Supply Chain Assessment combines secondary research with in-depth interviews of key market actors to establish the broader market context.

The evaluation team has undertaken the data collection for the Market Evaluation with two parallel sets of activities.

» ***End User Assessment:*** The End User Assessment gathers data about the view of energy efficiency from the end user's perspective. The research team has analyzed secondary data and is conducting a survey with end users (e.g., facility or energy managers). The information gathered includes key factors in decision making, opportunities for energy-efficient improvements, and characteristics of the firm and building.

» ***Supply Chain Assessment:*** The Supply Chain Assessment provides information about the broader market for energy efficiency in the priority market segments. This step developed a more comprehensive understanding of the context in which energy efficiency technologies and services are positioned. In addition, it will help to identify key trends that will shape the market in the next two to five years. The supply chain assessment relies on a literature review and in-depth interviews with key market actors.

Figure 2.1. Market Evaluation Activities

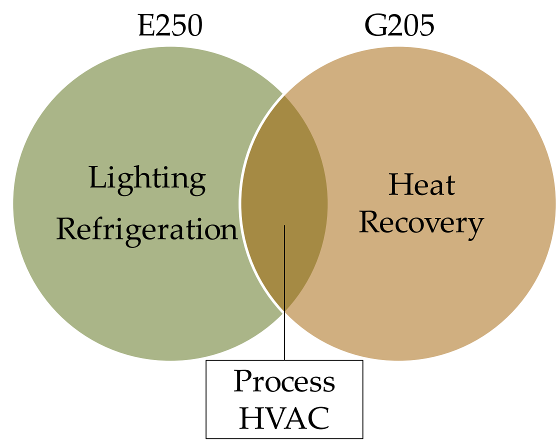


Source: Navigant 2011.

Together with PSE, the evaluation team identified five priority measure categories (*lighting, HVAC, refrigeration, process equipment, and waste heat recovery*) and four priority sectors (*offices, state and local government, hospitals, and industrial food processing*) for the data collection and analysis activities. This approach enables the project team to gather information with enough depth to provide actionable recommendations to PSE. The following discussion introduces the target measure categories and sectors and provides a high-level overview of the approach used to select them. Appendix A includes additional detail on the scoring of the measure categories and sectors.

The final list of priority measure categories has high savings potential as well as strategic priority within PSE's broader programmatic efforts. The evaluation team scored these measure categories based on a threshold number of projects and proportion of overall energy savings, recent increases in the value of incentives awarded, and recent increases in the amount of energy savings reported. PSE provided additional input regarding programmatic priorities. Figure 2.2 presents the final list of measure categories for each schedule that resulted from this meeting.

Figure 2.2. Final Set of Priority Measure Categories



Source: Navigant and PSE analysis 2011.

The evaluation team informed its selection of priority sectors on an analysis of the program-tracking databases and a high-level assessment of the efforts of nearby energy efficiency organizations. The team met with PSE staff to discuss the preliminary findings from those analyses and PSE infused the selection process with its programmatic priorities. As summarized in Figure 2.3, the evaluation focused its deeper analytical efforts on the following group of sectors:

1. **Offices –** As identified in the database analysis, offices have played an important role. Further, Northwest Energy Efficiency Alliance's (NEEA) recent efforts in this sector have prepared the market for more energy efficiency opportunities.
2. **Hospitals –** PSE sees hospitals as a growing sector. With recent NEEA efforts in this sector, the hospitals sector is likely ready for deeper utility engagement.
3. **Public Sector Buildings** (State and local government office-type buildings only; excludes wastewater treatment plants and school facilities.)

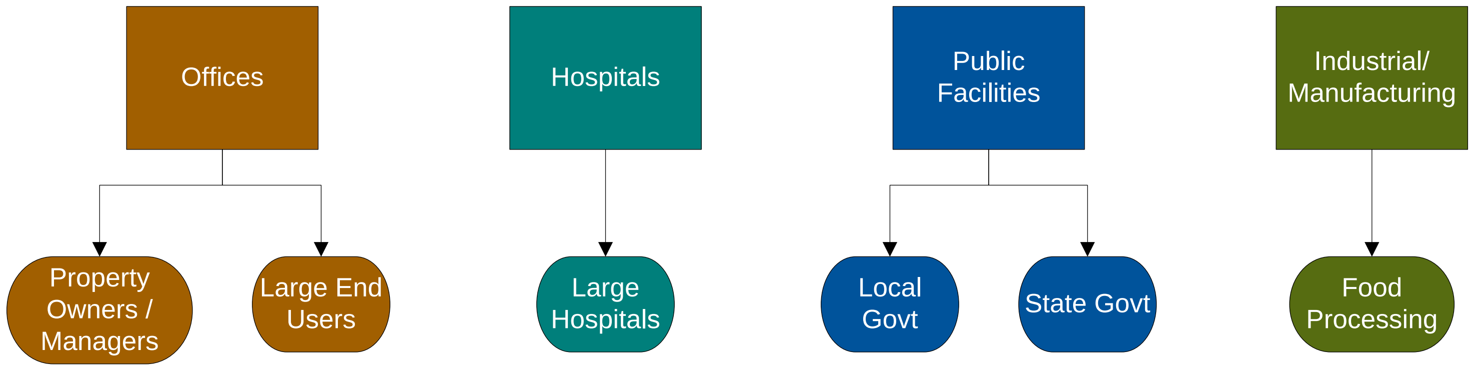
a. Wastewater treatment facilities are better categorized as industrial facilities; this research will not explore them in further depth.

b. Schools have received heightened attention over the past few years and likely have limited opportunities remaining.

4. **Industrial/Manufacturing[2] – Food Processing –**The PSE team sees a growing opportunity in this sector.

The research will focus on these sectors for both Schedule E250 and G205.

Figure 2.3. Final Sector Priorities



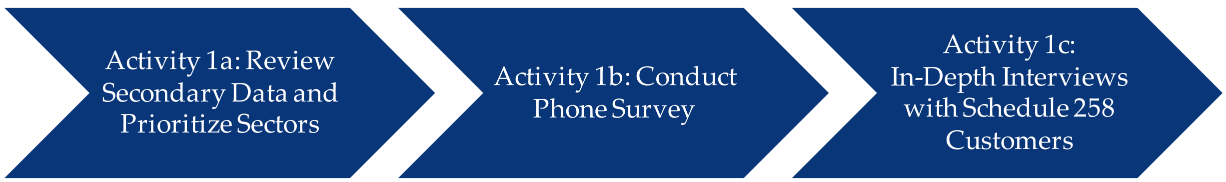
Source: Navigant and PSE analysis 2011.

[2] Data centers were originally included as a second sub-segment of the Industrial/Manufacturing sector. Initial research into this sector indicated that additional stand-alone data centers would likely locate in neighboring service territories due to a variety of factors. As such, PSE directed the evaluation team to eliminate stand-alone data centers from further consideration and focus on the remaining four sectors.

2.1.1 Activity 1: End User Assessment

The End User Assessment gathers information about decisions related to energy efficiency from the end user's perspective. This assessment combines secondary research with a survey of end users (e.g., facility or energy managers) to determine how end users make decisions about energy-efficient equipment, where potential exists for additional energy-efficient retrofits or behavior changes, and what PSE can do to facilitate the adoption of such equipment and practices. Figure 2.4 includes the general methodology.

Figure 2.4. Approach to End User Assessment



Following is an explanation of each of the sub-activities for the End User Assessment.

2.1.1.1 Activity 1a. Review Secondary Data and Prioritize Sectors

Secondary data sources provide an initial look at the current market conditions from the end user's perspective. Analysis of this data will provide a starting point for discussing the prioritization of practices. The key secondary data sources that the Navigant team referred to for this activity included the following:

- PSE's *Energy Efficiency Services 2010 Annual Report of Energy Conservation Accomplishments*[3]
- PSE's CSY databases for each program type
- *Commercial Building Stock Assessment* completed for NEEA[4]

2.1.1.2 Activity 1b: Conduct Survey

Navigant worked with its survey partner, Ewald and Wasserman Research (E&W), to undertake the main data collection effort for the End User Assessment: a survey with end users.

The evaluation team drafted a survey guide to address the research questions identified in Table 2-1. PSE staff added particular value to this process by sharing their broad knowledge of the market for energy efficiency products and services within their service territory. Tailoring the survey to the issues faced by PSE customers and highlighting issues of particular importance to PSE staff helped to focus data collection efforts where they add the most value.

The evaluation team used two key strategies to increase the response rate to the survey in an effort to reduce self-selection bias. First, Navigant and E&W coordinated a letter mailing with PSE to the

[3] PSE. 2010. "Energy Efficiency Services 2010 Annual Report of Energy Conservation Accomplishments."
[4] Cadmus Group. December 2009. *Northwest Commercial Building Stock Assessment.* Northwest Energy Efficiency Alliance.

organizations included in the survey sample. The team has found that a letter received in advance of the survey significantly increases response rate. This letter was sent on PSE letterhead and in a PSE envelope. It introduced the survey team and informed the targeted participants about the purpose of the study. Further, all individuals who participate in the survey will be entered into a drawing for one of two $100 Visa check cards.

2.1.1.3 Activity 1c: Interviews with Schedule 258 Customers and Key Account Representatives

Activity 1c addresses the Large Customer Self-Directed program (258). Given the specialized nature of these customers and projects, in-depth interviews will allow the evaluation team to achieve the following goals:

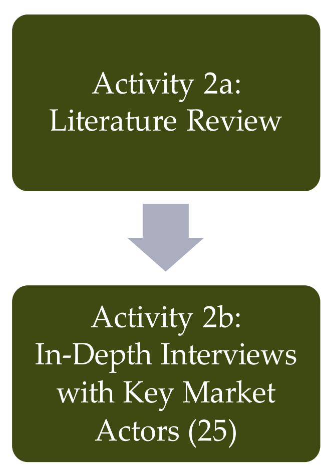
- Determine the extent to which additional project opportunities remain
- Assess the barriers to completing the remaining projects

The evaluation team met with PSE to select the target customers for this segment. The group separated the customers that are eligible for Schedule 258 into three categories based on the PSE team's assessment of their participation in the energy efficiency programs over the past two years. The target sample included four customers with relatively high levels of participation (High or Medium-High), four customers with moderate levels of participation (Medium), and four customers with relatively low levels of participation (Medium-Low or Low). The group identified an additional four customers as alternates in the event that any of the priority customers chose not to participate.

A Navigant team member with deep experience with large customers conducted in-depth phone interviews with these target customers. This individual developed a high-level interview guide (included in Appendix B) to facilitate identification of additional project opportunities and discussion of barriers to project completion.

2.1.2 Activity 2: Supply Chain Assessment

The Supply Chain Assessment incorporated a review of relevant literature and in-depth interviews with key market actors. Activity 2 assembles the information needed to undertake the main data collection effort for this part of the project: a set of in-depth interviews with contractors that install energy efficiency equipment, energy service companies (ESCOs), technology distributors, and key industry associations that are active in the service territory. This section outlines the approaches to the two activities, the Literature Review (Activity 2a) and In-Depth Interviews (Activity 2b).



2.1.2.1 Activity 2a: Literature Review

The literature review provides an overview of the state of the industry's knowledge about the supply chain's approach to distributing energy technologies into the C&I sectors. By leveraging the work already done, the evaluation team targeted the in-depth interview questions toward the issues that have not been previously explored in sufficient depth.

The literature review focused on the sectors identified in Activity 1a. Navigant completed a comprehensive review of the literature on program best practices nationally in these sectors and can leverage the lessons learned in the evaluation of PSE's Schedules G205 and E250.
In addition, the evaluation team provides a high-level look at the *technologies* that are likely to have a significant impact in the C&I markets in the next two to five years. This effort leveraged Navigant's current work in other parts of the country to identify technologies that either (1) have achieved limited market acceptance to date but are poised to expand their reach, or (2) have the potential to emerge in the marketplace in the mid-term and could have greater success with utility support.

2.1.2.2 Activity 2b: In-Depth Interviews with Key Market Actors

Market actors who serve as trusted advisors to end users serve as the most cost-effective means for collecting data about current sales strategies and the anticipated direction of the market. These market factors include energy efficiency service providers (e.g., ESCOs, contractors, and engineering firms or consultants), trade associations, and equipment distributors. They interact with both distributors and customers, providing them with the opportunity to describe which sales strategies work with customers and to identify high-impact emerging products and services.

The Navigant team worked with PSE to develop a group of targeted market actors that leverages existing resources and achieves a sample diverse enough to achieve the study objectives. Navigant conducted analysis of the program databases to identify specific program participants to interview; the in-depth interviews targeted those participants that have achieved high levels of energy savings or that lead in terms of the number of projects completed. The Market Evaluation Team coordinated with the Process Evaluation Team to ensure that Energy Efficiency Service Providers were only contacted once as part of the in-depth interview efforts.

The evaluation team interviewed a total of 25 market actors for this effort. Table 2-2 includes a breakdown of these interviews into the categories described earlier. Appendix C includes the final interview guide for each category of market actors.

Table 2-2. Composition of Market Actor Interviews

Market Actors	Types of Organizations Interviewed	Number of Interviews
Energy Efficiency Service Providers	ESCOs	4
	Engineering Firms/Consultants	2
	Contractors	HVAC: 2 Lighting: 3
Trade Associations (Specific to priority sectors)	» Building Operators and Managers Association » International Facility Managers Association » Department of General Administration » Northwest Food Processors Association » Washington State Hospitals Association	5
Equipment Distributors (Specific to priority measure categories)	HVAC, Lighting, Pumps, Refrigeration, Waste Heat Recovery	HVAC: 1 Lighting: 2 Pumps: 3 Refrigeration: 2 Waste Heat Recovery: 1

Source: Navigant analysis 2011.

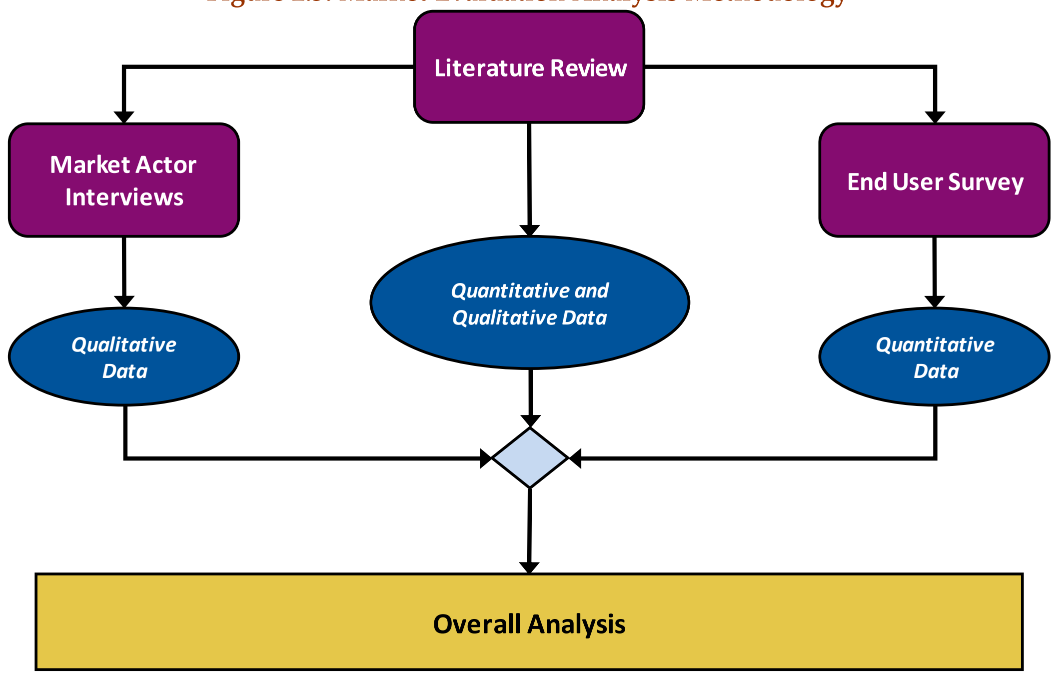
Section 2.2.1 includes additional information about the role of each type of market actor.

2.1.3 Analysis

The results of the Market Evaluation rely on the results of surveys with end users, interviews with the key market actors, and the examination of PSE's existing resources and additional secondary resources.

The analysis focuses on the information that is most useful to PSE in its design and enhancement of its C&I energy efficiency programs, as identified above. The evaluation team identified themes that emerge in the primary data collection efforts and characteristics that define market segments with high potential to respond to PSE intervention. Navigant's analysis incorporates qualitative data collected through interviews, quantitative data from the end user surveys, and a mix of qualitative and quantitative data collected through the literature research exercise, as shown in Figure 2.5.

Figure 2.5. Market Evaluation Analysis Methodology



Source: Navigant analysis 2011.

In addition to addressing the research questions, this report enumerates specific opportunities for PSE's intervention in the marketplace. The team seeks to make the recommendations actionable for PSE staff, using the analysis from the data collection efforts as justification for the recommendations. This data-driven approach will provide PSE with the information needed to enhance program design with confidence that the adjustments will improve overall program performance.

2.2 *Findings*

This section presents the findings of the Market Evaluation. It relies on the data collection efforts already completed. In large part, these findings rely on the market actor interviews, the literature review, and the evaluation team's experience in C&I markets across the country. Together, these analyses will provide clearer direction than can be provided at this time.

This discussion is organized in three sections:

» Section 2.2.1 includes a discussion about the structure of the market, including descriptions of key market actors and the relationships among them (Section 2.2.1.1) and a summary of two of the key mechanisms used in the market: approaches used to promote energy efficiency and financing strategies (Section 2.2.1.2).

» Section 2.2.2 describes trends affecting the C&I retrofit market, including drivers and barriers (Section 2.2.2.1), changes to codes and standards (Section 2.2.2.2), and technologies that are expected to have an impact on the market in the next two to five years (Section 2.2.2.3).

» Section 2.2.3 includes discussions about the direction of the priority sectors that served as the focus of this report: offices (Section 2.2.3.1), the public sector (Section 2.2.3.2), hospitals (2.2.3.3), and food processing (Section 2.2.3.4).

2.2.1 Market Structure

For most C&I energy end users, designing and installing energy efficiency retrofits falls beyond the organizations' core competencies. Choosing appropriate equipment and modifying complex building systems (e.g., electrical or HVAC) requires specialized knowledge and skill sets that most end users do not possess among their in-house staff. The market for retrofit projects has responded, with a variety of companies offering products and services along the supply chain – everything from narrowly targeted products or services to integrated equipment selection, design-build and project financing. These firms vary in size, geographic focus, and the degree to which energy efficiency plays a role in their overall business strategy.

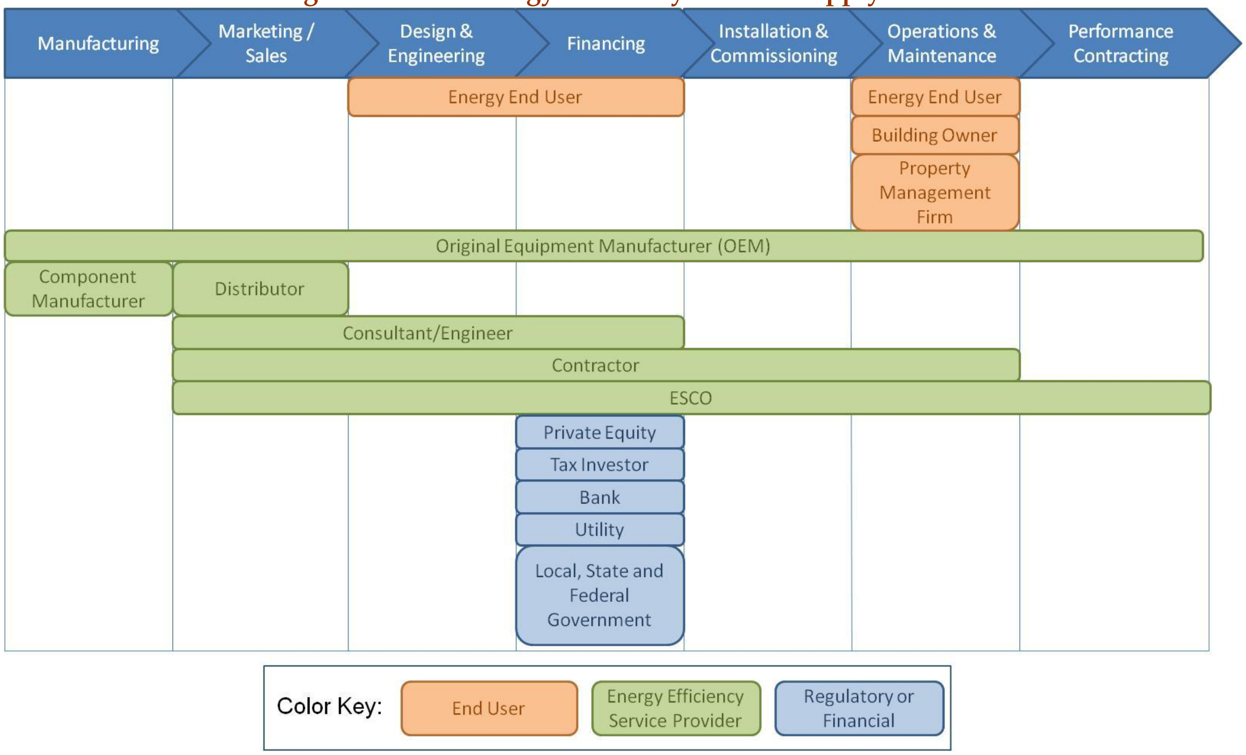
This section begins by describing the service providers and market actors that comprise or influence the supply chain for C&I energy efficiency retrofit projects and highlighting some of the common relationships among different types of firms (Section 2.2.1.1). It then summarizes two of the key market mechanisms used by service providers:

- the sales strategies firms use to generate business and
- common project financing models (Section 2.2.1.2).

2.2.1.1 Market Actors

The market actors relevant to this study fall into three groups: energy end users, energy efficiency service providers, and third-party institutions that provide either regulatory or financial inputs that influence the market for efficiency retrofits. Figure 2.6 illustrates the key market actors and their roles in the energy efficiency retrofit supply chain. The following subsections summarize the characteristics of and services provided by the market actors in each of these categories.

Figure 2.6. C&I Energy Efficiency Retrofit Supply Chain



ENERGY END USERS

This market actor category comprises the broad array of non-residential energy end-use customers that consume electricity and natural gas through the course of their daily operations. These organizations, both private-sector businesses and public-sector institutions, drive overall demand for energy efficiency retrofits and high-efficiency equipment; they are the primary decision makers when it comes to investing in and implementing a retrofit project.

In cases where the energy end user does not own the facility it occupies, the organization will need to coordinate with (and sometimes convince) the building owner or property management firm to complete the project. This often leads to a split-incentive problem between the building owner and the end user (tenant), wherein the building owner is disincentivized to make capital improvements to its facility if its tenant will capture the majority of the benefits from reduced energy use. Section 2.2.3 provides additional characteristics about energy end users in each of the four target sectors upon which this assessment focuses.

ENERGY EFFICIENCY SERVICE PROVIDERS

The energy efficiency services sector comprise diverse business types and capabilities, all linked in some capacity to the design and delivery of retrofit projects to energy end users. Different companies may offer anywhere from one specific service (e.g., lighting installation) to an entire suite of services spanning the retrofit project development value chain (e.g., ESCOs). While the lines dividing different types of firms are increasingly blurred by overlap, this assessment groups these companies into four general categories: equipment manufacturers and distributors, consultants and engineers, contractors, and ESCOs.

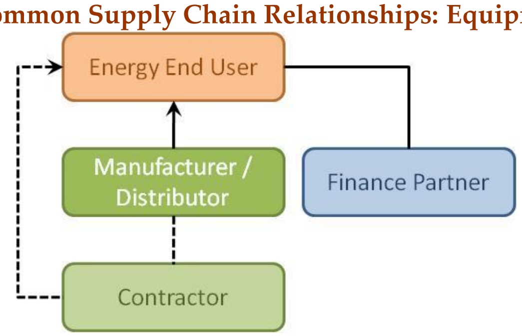
These firms vary considerably in both geography and size. While some operate predominately in Washington State or even the Seattle metropolitan area, several serve customers across the Pacific Northwest (PNW), the nation, and even the globe. This broad reach is particularly characteristic of the larger equipment manufacturers and ESCOs. In terms of size, more than 75 percent of related PNW firms have 100 or fewer employees, while 34 percent have ten or fewer employees.[5] The smaller size of many of these firms may indicate a high degree of specialization in the capabilities and services offered by a single firm (e.g., a lighting retrofit contractor).

Regardless of a company's size, energy efficiency often represents only a portion of many of these firms' revenues or service offerings. For others, retrofit projects may drive the majority of their business. The following descriptions compare the common characteristics and supply chain roles of each of the four primary service provider categories. The graphic under each heading illustrates the typical relationships among different market actors when that section's service provider is acting as the primary project driver.

Equipment Manufacturers & Distributors. Business models range as widely among equipment manufacturers and distributors as they do among efficiency service providers generally. Categories of larger equipment (e.g., HVAC) are characterized by the presence of regional sales representatives from well-established, global manufacturers who work with other service providers (or directly with end users) to market and sell their equipment. Other categories (e.g., lighting) tend to have several independent distributors who may offer products from one or several major manufacturers. For pumps and motors, some equipment providers sell equipment constructed by their own companies as well as that of competing manufacturers.

The variety of equipment providers' approaches to the energy efficiency market also extends along the value chain. As shown in Figure 2.7, some equipment providers and manufacturers design and engineer a project for a customer using the specified equipment, but have a third-party contractor install the equipment. The contractor may operate either under subcontract to the equipment provider or under direct contract to the customer. Some equipment manufacturers and distributors also offer financing, design and installation services directly to end use customers. For example, Trane, one of the leading HVAC manufacturers, has a separate division that provides complete ESCO services.

Figure 2.7. Common Supply Chain Relationships: Equipment Provider

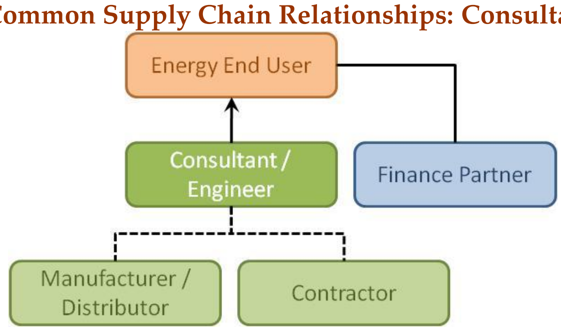


[5] Goldman, C., et al. 2010. "Energy Efficiency Services Sector: Workforce Size and Expectations for Growth." Ernest Orlando Lawrence Berkeley National Laboratory.

The role energy efficiency plays in different equipment providers' business ranges considerably. Both HVAC and lighting equipment providers reported that energy efficiency represents a primary share of sales and revenue. This may reflect the degree to which these two equipment categories have historically been the primary source of cost-effective energy savings for retrofit projects. On the other hand, providers of refrigeration, motor, and pump equipment reported that non-high-efficiency equipment still plays a major role in their business.

Consultants & Engineers. Energy consulting firms and engineering companies can provide a suite of services to end-use customers, ranging from initial identification and prioritization of energy savings opportunities to project design and construction management. While larger firms may provide wide-ranging expertise, some choose to focus on either a particular equipment category (e.g., lighting) or end-user sector (e.g., commercial real estate). This targeted approach may arise for several reasons, including staffing limitations of smaller firms or a desire to differentiate the company through specialization. As with equipment providers, the consultants and engineers operating within PSE's service territory range from smaller local firms (e.g., fewer than 10 employees) to larger firms with national coverage. In addition, energy efficiency-related services may provide anywhere from a small portion to the bulk of an engineering or consulting firm's business.

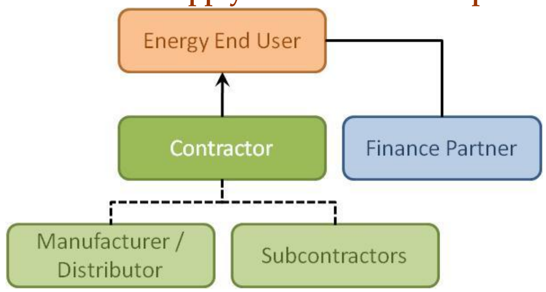
Figure 2.8. Common Supply Chain Relationships: Consultant/Engineer



As mentioned above, *the consultant or engineer may provide construction management services in addition to project design and engineering*. This typically involves the firm either acting as the owner's agent in soliciting competitive bids and overseeing contractors (paid for directly by the owner) or directly subcontracting and managing the construction process themselves, as shown in Figure 2.8 . In some cases, an engineering firm that specializes in a particular discipline (e.g., lighting retrofits) may self-perform the installation of associated equipment on a particular project. In addition, engineering firms may also provide end-use customers with financing options, either through internal funds or by connecting the customer to a third-party lender. Unlike an ESCO, an engineer does not offer performance contracting.

Contractors. Most contractors specialize in a single discipline, such as electrical or mechanical (e.g., HVAC) systems. Primarily focusing on the installation and construction phase of projects, they often serve as subcontractors to an equipment provider, engineering firm, or ESCO on a retrofit project. On the other hand, as shown in Figure 2.9, some contractors offer integrated design-build services, utilizing in-house engineering expertise to both design and construct a project. Similar to other firms, they will competitively bid and subcontract work for the disciplines in which they are less experienced.

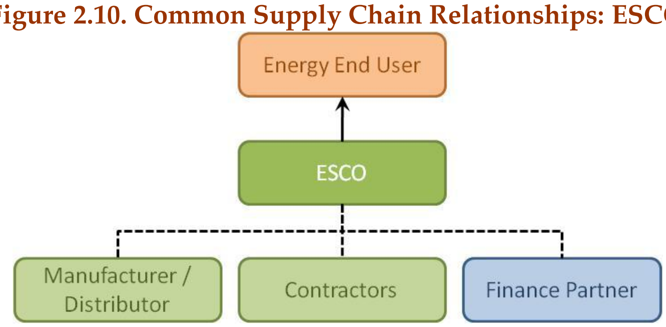
Figure 2.9. Common Supply Chain Relationships: Contractor



While far from widespread, some contractors have also begun offering financing assistance to customers for energy efficiency retrofit projects, primarily through arrangements with third-party lending institutions. In general, contractors derive a smaller share of their business from energy efficiency-related work than engineers or ESCOs, particularly in the mechanical and HVAC (as opposed to lighting and electrical) disciplines.

ESCOs. As shown in Figure 2.10, ESCOs provide end-use customers a complete suite of services related to energy efficiency retrofits – from initial conception and pricing to turnkey engineering and installation, as well as measurement and verification. However, *the key differentiator between an ESCO and any other "full-service" engineering firm or design-build contractor arises from the ESCO's ability to offer a performance contracting mechanism.* The performance contract provides a vehicle for the end-use customer to implement a retrofit project with little to no upfront capital investment. Instead, the end user agrees to pay back the ESCO over time (with interest) based on the energy and operating cost savings created by the efficiency project. The ESCO secures affordable third-party financing by combining a portfolio of potential projects with a reputation for high-quality design and delivery.

Figure 2.10. Common Supply Chain Relationships: ESCO



This savings-based project finance approach enables ESCOs to provide a unique and attractive offering to end-use customers and to secure relatively large projects that otherwise would have trouble finding funding. In particular, public sector entities such as hospitals and K-12 schools with little funding available for efficiency improvements can utilize performance contracting to achieve substantial reductions in energy use and operating costs without large capital outlays. This so-called municipal, university, school, and hospital (MUSH) market represented 69 percent of U.S. ESCO revenues in 2008, an increase from 2006.[6,7] ESCOs interviewed in PSE's service territory indicated that this trend was continuing, with decreased likelihood of performance contracting among private-sector customers.

Some ESCOs strive to self-perform all installation and construction for a project, with the dual aim of minimizing costs and tightly controlling quality. On the other hand, others generally subcontract all or a large portion of project's construction. Some cite a desire (or requirement under government contracts) to maximize use of local subcontractors, while others explain that their core competencies lie in the identification, design, and financing of profitable projects not in their construction. Similarly, while some ESCOs that participated in the in-depth interviews conducted for this project indicate that energy efficiency related services provide up to half of their revenues, others report ranges between 15 and 33 percent. For many of these larger firms, energy efficiency services represent only one of several business lines.

Regulatory and Financial Market Actors

The final general category of actors affecting the C&I retrofit supply chain comprises third-party organizations that influence the market through various policies and regulations and by making capital available to finance projects. The first of these two influences—policy and regulation—falls primarily to the local, state and federal lawmakers and agencies that set the rules governing energy generation and transmission, utility operations and sales, building codes, and other relevant issues. The specific policies affecting the C&I energy efficiency retrofit market in the PNW are discussed in detail in Section 2.2.2.1.

The second of these influences—the availability of capital—involves a wide range of third-party organizations that work either with the service provider firms described above or directly with end use customers to help finance retrofit projects. Each of these market actors makes capital available in the following ways.

Banks, Private Equity Firms, Tax Investors. These traditional lenders provide funds for retrofits, either in aggregate by funding a portfolio of projects through an ESCO or engineer, or directly to the end customer. In many cases, the reduced risk created by large service providers' expertise and portfolio approach to energy retrofit projects makes them better able to acquire funds than individual customers may be able to achieve alone.

Utilities. Electricity and natural gas utilities, such as PSE, provide incentives for energy efficiency retrofit projects under a variety of programs and focus areas.

Local, State, and Federal Government. Through various programs, grants, and policies, government agencies provide additional incentives for energy efficiency projects. These include economic stimulus-related funds such as the Energy Efficiency Conservation Block Grants (EECBGs) and State Energy Program (SEP) funds, among others detailed in Section 2.2.2.1. In addition, the Washington State Department of General Administration provides various public institutions access to an Energy Savings Performance Contracting (ESPC) Program. While not a direct source of funds itself, the ESPC provides

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[6] The other MUSH segments are municipal and state government and universities and colleges.

[7] Goldman, C., et al. 2010. "Energy Efficiency Services Sector: Workforce Size and Expectations for Growth." Lawrence Berkeley National Laboratory.

assistance to publicly owned facilities in selecting and working with a pre-qualified ESCO to implement energy conservation measures without any capital outlay.[8]

2.2.1.2 Market Mechanisms

This section discusses two of the key market mechanisms employed by market actors to help facilitate the development and implementation of retrofit projects. The first subsection discusses the various marketing channels and strategies *used by energy efficiency service providers* to reach customers and sell projects, and the second summarizes the common finance structures employed to fund retrofits.

MARKETING CHANNELS AND SALES STRATEGIES

The sales channels and strategies companies rely upon to generate business are as diverse as the business models and relationships employed by the various firms in the C&I retrofit project supply chain. However, several common themes emerged as the primary business development strategies across all four service provider categories. They include (in no particular order):

- Growing relationships with existing customers (repeat customers)
- Referrals from past and existing clients (i.e., word of mouth)
- Direct sales (e.g., cold calls and "knocking on doors")
- Responding to competitive solicitations (i.e., requests for proposals)
- Networking opportunities (industry trade shows, customer trade organization events)

[8] State of Washington: General Administration. June 2010. "Washington's Program." http://www.ga.wa.gov/eas/epc/municipal.htm

In addition, one or more interviewed service providers mentioned the following strategies as being important to generating leads and winning work.

Proforma Financial Analysis. Several (but not all) interviewed firms explained that they use proforma financial calculations to show customers their expected return on investment (ROI) or payback period for the proposed project. One ESCO additionally mentioned including calculations of projects' carbon footprint reductions alongside the financial analysis. Firms explicitly include forecasted utility incentives in their proforma calculations, citing the importance of utility incentives in moving many projects forward.

Informal Channel Partnerships. While most relationships among service providers remain informal, several firms mentioned the importance of these relationships in generating leads for projects. In particular, equipment providers receive numerous sales opportunities (several estimated about half of their business) from other service providers. Similarly, an ESCO or engineer's informal partnership with or past purchases from a national equipment manufacturer or distributor can generate leads from end-use customers that prefer that provider's equipment. The equipment provider is more likely to refer the customer to a firm that it knows to have previous experience installing and commissioning its equipment. Finally, several contractors also cited being called on by ESCOs and engineering firms to provide competitive bids for projects on a regular basis or as a pre-qualified bidder.

Vertical Integration. In an effort to internalize the benefits of such referrals, some manufacturers and distributors vertically integrate their offerings by starting (or acquiring) a business that offers energy consulting or ESCO services to end-use customers. These subsidiary or sister firms find fungible projects, design the project (specifying the manufacturer's equipment), and solicit and manage any subcontractors required for completion of the retrofit.

Leveraging National Relationships. Rather than looking across the value chain, some engineering firms and ESCOs with a regional or national presence leverage relationships with end-use customers who have several large facilities in multiple locations (e.g., a big box retailer or large commercial real estate firm).

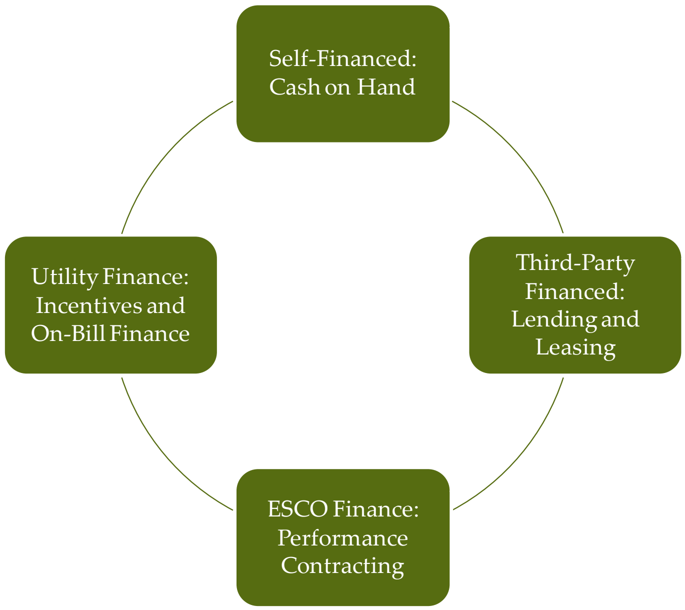
Enhanced Capabilities. Finally, two ESCOs specifically mentioned the potential marketing opportunities created by increasing interest in building management systems and the emerging data analytics capabilities associated with them. The potential improvements such analytics can provide for system monitoring and performance can add greater value to ESCOs offerings, particularly under a performance contracting model.

FINANCING MODELS

Various financial institutions and partners offer service providers and end-use customers opportunities to help fund efficiency retrofit projects. As will be discussed further in Section 2.2.2, the economic downturn has substantially reduced the availability of capital for retrofit projects, despite some owners' increased interest in making such investments. Service providers reported that lending organizations' have become far more selective about the projects for which they will provide funding and are less willing to provide capital for longer-term paybacks (e.g., 15 years).

Several companies affirmed that the downturn has made the availability of alternative financing mechanisms (e.g., performance contracting, grants, etc.) much more important to project viability, especially for public sector customers with cash-strapped budgets. The remainder of this section summarizes the most common project finance structures used in the C&I retrofit market.[9] Figure 2.11 outlines the types of financial structures discussed in this section.

Figure 2.11. Models Used to Finance C&I Energy Efficiency Retrofit Projects



Source: Navigant analysis of market actor interviews 2011.

Self Financed: Cash on Hand. For end-use customers with cash available, self-financing an energy retrofit project commonly provides the greatest return on investment. When the customer does not have to borrow funds from a bank or a service provider, they do not have to factor in interest payments or other lending fees.

Third-Party Financed: Lending and Leasing. Many customers do not have sufficient cash on hand, have other priorities competing for their capital, or simply do not wish to invest spare capital given the risky economic climate. In this case, the customer may seek funding from either a bank (or bonds, in the case of public agencies) or directly from the service provider completing their project. Many service providers maintain informal partnerships with and introduce potential customers to such lenders in the interest of facilitating loans for projects. One firm reported that it will even issue a request for proposals (RFP) to financial institutions on behalf of their customers to find financing. In most situations, the service provider does not take a direct financial stake in the loan transaction.

Occasionally, some service providers may provide direct financing for their customers' projects. They may do so either from funds the firm borrows from a bank or cash on hand; one engineering firm has a

[9] A more detailed discussion of the key considerations among the different financing mechanisms available to support building efficiency upgrades can be found in the U.S. EPA's ENERGY STAR Building Upgrade Manual, Chapter 4. Available online at http://www.energystar.gov/ia/business/EPA_BUM_Full.pdf.

"slush fund" available for projects ranging from $50,000 to $1 million. In either case, the rate of return the service provider expects to earn from the combination of project fees and interest charged to the customer must cover the firm's cost of capital.

Such third-party financing commonly takes two forms:

» In the first, the bank or service provider provides a **simple loan** to the end-use customer. If the lender is a trade ally, they charge an interest rate sufficient to cover their own borrowing costs or the opportunity cost of keeping those funds in a savings account.

» The second, but less common, form of third-party financing uses a **lease agreement** (sometimes called an energy efficient equipment lease). In this model, the third party covers the upfront cost of the equipment and charges the customer a monthly lease payment roughly equal to the savings expected from reduced energy usage. In the case of a capital lease,[10] the customer can effectively buy out and take ownership of the equipment once the capital cost (including any leasing fees) has been paid back to the third party. The contractor that cited this financing model suggested it was well-suited to lighting retrofit customers because utilities essentially verify those projects' expected savings through their incentive programs. This helps to reduce savings uncertainty for the customer.

Several service providers mentioned that they are more likely to *facilitate* third-party financing for customers (as discussed in the previous subsection) rather than holding a loan or lease on their own balance sheet. For example, one ESCO that formerly offered first-party financing reported that they converted to offering exclusively third-party financing in fall 2008.

ESCO Financed: Performance Contracting. Performance contracting is a common form of project finance arrangement offered directly by an ESCO. Similar to the energy efficiency lease agreement, the ESCO designs and installs a retrofit project that can be paid back over the contract term based on the customers' savings from reduced energy consumption. However, in this case the ESCO guarantees the level of savings to the customer and takes on the financial risk that the project may fall short of projections. This encourages the ESCO to help monitor, maintain, and optimize the performance of the installed equipment.

The performance contract plays an essential (and increasing) role in many public sector and non-profit projects (e.g., MUSH). Many of these organizations have received institutional directives to reduce energy use and operating expenses. However, most lack the capital to pursue retrofit projects (even those with short-term paybacks). The performance contract helps reduce that barrier. In addition, because it is typically paid out of operating expenses, the performance contract does not appear on the customer's balance sheet.[11]

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[10] A capital lease essentially allows a customer to purchase equipment through installment payments. For accounting purposes, this lease is considered a purchase and will appear on a customer's balance sheet. An operating lease, on the other hand, is not considered a purchase because the equipment is assumed to remain the property of the lessor. PSE staff indicate that a few contractors that participate in the C&I Retrofit program use this structure.

[11] U.S. EPA. October 2008. "ENERGY STAR Building Upgrade Manual." Environmental Protection Agency. (http://www.energystar.gov/ia/business/EPA_BUM_Full.pdf)

The number and size of projects using performance contracts require a substantial amount of capital. To meet this need, ESCOs typically turn to outside investors such as investment banks, private equity funds, or tax equity investors. An individual end-use customer my face difficulties in securing funds for large, energy efficiency retrofits. On the other hand, ESCOs' familiarity with and reputation in the energy efficiency marketplace improves their ability to secure third-party financing.[12]

Utility Finance: Incentives and On-bill Financing. A majority of the trade allies interviewed cited utility incentives' importance to the economic viability of most C&I retrofit projects. While in some cases it may simply improve a project's economics or help it to achieve a customer's internal hurdle rate, many projects would simply not be implemented without the incentives. When asked what additional steps utilities could take to facilitate implementation of retrofits, several trade allies cited the success of on-bill financing in other utility territories (e.g., San Diego Electric & Gas).

When asked what additional steps utilities could take to facilitate implementation of retrofits, several trade allies cited the success of on-bill financing in other utility territories (e.g., San Diego Electric & Gas).

On-bill financing works on a similar principal as an equipment lease or performance contract. The utility lends the customer all or a portion of the upfront cost of a project and collects repayment of the loan through the customer's monthly energy bill. The utility calculates the monthly loan payment to approximately match the expected average monthly savings from reduced energy use that will result from the project. This finance model takes advantage of an existing loan collection mechanism, thereby eliminating the customer's hassle of another monthly transaction and providing the utility increased certainty of repayment (most organizations pay their monthly energy bill). Unlike performance contracting, however, on-bill financing does not guarantee the level of savings the customer will achieve each month, leaving them exposed to the risk that a project underperforms.

A high level review of several on-bill financing program evaluation reports concluded that utilities have had success with on-bill financing programs and that there are emerging lessons learned from existing programs in the market. This review included programs from four utility territories (Midwest Energy, Hawaiian Electric Company, United Illuminating, and SoCalGas/SDG&E) and captured the following considerations and solutions: Table 2-3 includes the results of this analysis.

[12] Many of these firms are part of larger engineering or manufacturing companies with long histories and large balance sheets that reduce the risk to potential lenders. In addition, combining several performance contracts into a portfolio further reduces the risk that any one project will underperform and inhibit the ESCO's ability to meet its obligations to lenders.

Table 2-3. Four Utilities' Approaches to Addressing Challenges of On-Bill Financing

Risk Considerations	Possible Solutions
Low Participation	» Segment audience during design process » Target specific demographic or geographic area » Ensure payback and up-front costs are assessed during design process and set motivating product qualifications and loan terms » Integrate contractor pool early on to ensure they market the program » Integrate offering with other programs, such as rebates and energy audit services » Market the program adequately » Ensure the program processes are simple for the customer to understand and navigate » Leverage usage data for audience segmentation
Customer and Contractor Dissatisfaction	» Streamline application process to make it simple for participants » Integrate contractors during the design process to ensure buy-in and satisfaction » Embrace program as a customer service opportunity and consider customer service goals during the design process » Ensure prompt payment for contractors » Ensure that savings are visible on customer's bill
Legal Issues	» Review federal, state, and local laws during the design process » Ensure that debt ownership is clearly outlined and compliant with all regulations » Review lending laws thoroughly during the design process
High Administrative Costs	» Invest in staff training and streamlining tools up front » Integrate program with existing systems and tools whenever possible » Assess functionality of existing billing system early on in the design process to ensure tools are leveraged and to identify where adjustments will be needed » Invest in contractor training and outreach and leverage contractor pool as a resource
Customer Default	» Set loan terms that ensure the project provides immediate cost savings to the customer » Develop clear and appropriate credit requirements early in the design phase » Enforce customer credit requirements consistently and aggressively
Sources: Johnson, K., et al. 2010. "Lessons Learned from the Field: Key Strategies for Implementing Successful On-The-Bill Financing Programs" Johnson Consulting Group. Hyams, Michael A., 2009. "On-Bill Financing for Energy Efficiency" Columbia University. Spasarp, Frank, 2011. "On Bill Financing: SDG&E/SoCalGas" US China Energy Efficiency Forum.	

2.2.2 Key Market Trends

This section describes the key trends that affect the C&I market's adoption of energy efficiency retrofit projects. It provides additional context as PSE considers which markets are best to target and how to engage with key decision makers in those markets. The market continues to shift at a rapid pace, as the firms regain confidence in the market, policymakers decide to focus more on energy efficiency, and the pace of technological change continues to accelerate. The snapshot provided in this section presents the market factors that are most important to the market today and provides some insight into how the market may shift in the future as the context changes. PSE's relationships with key market actors will continue to provide input to PSE's efforts to influence the market as program implementation evolves.

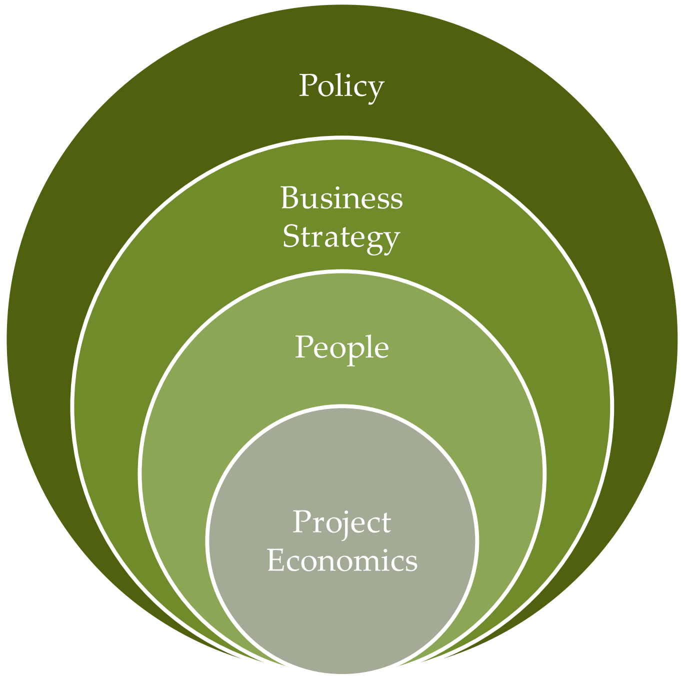
The first part of this section (Section 2.2.2.1) focuses on the drivers and barriers to energy efficiency in the C&I market in the Northwest. The second part of the section (Section 2.2.2.2) begins to explore the implications of changing codes and standards in the region. Finally, the section concludes (Section 2.2.2.3) with a high-level discussion of technologies that have the potential to make an impact on PSE's energy savings targets in the next two to five years.

2.2.2.1 Drivers and Barriers

The drivers and barriers to energy efficiency projects in PSE's service territory have evolved in the past few years. New policies have promoted energy efficiency more visibly than previous ones. While project-level metrics have largely remained the same (return on investment [ROI], payback period), the corporate strategy context within which companies considered them has changed.

Figure 2.12 depicts a framework that the evaluation team used to consider the drivers and barriers to energy efficiency at commercial and industrial facilities in PSE's service territory. The framework first considers the factors with influence over the entire market: **policies** that promote and hinder the adoption of energy efficiency. The next level of analysis considers a set of forces that drive decisions at the organizational level: **business strategies,** which include those goals and strategies established by both private- and public-sector organizations to guide resource allocation decisions. The third set of drivers and barriers relate to a group that has the least amount of consistency among these four levels: **people**. The final set of forces has a significant influence over decisions at the project level: **project economics**.

Figure 2.12. Framework for Considering Drivers and Barriers to Energy Efficiency



Source: Navigant analysis 2011.

The economic downturn that began in late 2008 has had a substantial and multi-faceted effect on the C&I energy efficiency retrofit market. While increased economic uncertainty and tighter capital markets have inhibited project implementation, the drive to reduce operating costs combined with the availability of grants and incentives have partially offset these barriers. This section summarizes several key trends identified by service providers that relate specifically to the economic downturn.

Together, these organizational level drivers and barriers have created a disconnect between **end users' interest in and ability to implement** retrofit projects. Several service providers suggested customers' ***willingness* to pursue projects that had stayed the same or increased** since the start of the recession, due to the drivers stated previously. Their *ability* to implement projects, however, has diminished in many cases due to competing priorities for reduced capital funding internally and unwilling lenders externally. As a result, service providers report that the time to complete a project sale has increased dramatically (e.g., from a six- to nine-month cycle to a cycle that lasts 18-24 months). When the sales cycle is complete, companies sometimes move forward with a smaller project than originally scoped.

POLICY

Policies at the federal and state levels have played significant roles in the adoption of energy efficiency in the C&I markets in recent years. At the federal level, the **American Recovery and Reinvestment Act (ARRA)** of 2009 made $6.3 billion available to state and local governments to promote energy efficiency through the **Energy Efficiency Conservation Block Grants (EECBG)** and **SEP** funds. Some local governments opted to use part of their share of EECBG funds to invest in energy efficiency upgrades in county and municipal government facilities, while other portions of the funds leveraged private funding to support upgrades at private facilities.

In parallel, a **federal tax deduction for energy efficiency in commercial buildings** added another financial incentive for private-sector building owners. The $1.80/square foot tax deduction applies to both new and existing buildings that reduce energy cost and use by 50 percent or more when compared to that building's expected performance under the American Society for Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 90.1-2001; the building owner can achieve the energy reduction through lighting, HVAC, or building envelope improvements.[13] Alternately, a smaller tax deduction ($0.60/square foot) is available to building owners that install certain equipment that could reasonably achieve, in combination with other measures, the 50 percent reduction in energy.

Washington State's **State Jobs Act** allocated $100 million to energy efficiency in K-12 schools and higher education during 2010.[14] This competitively bid funding[15] drove significant improvements and investment in the schools sector. Several contractors indicated that these funds, which were matched by funds from other public and private sector entities, achieved much of the energy efficiency available in the schools sector.

Finally, Washington State's **energy efficiency resource standard,** originally passed through voter initiative **I-937**, is not a major driver for PSE's customers. Although I-937 drives utility procurement of conservation resources[16], contractors did not identify it as a major driver for customer decision making. This seems reasonable since I-937 is designed to drive acquisition of energy efficiency from the utility perspective. Contractors did cite utility incentives (which relates to I-937) as a driver but not the policy itself.

The only policy-level barrier that contractors mentioned related to an unintended consequence of the state's **energy codes**. As the codes become more rigorous, end users perceive that they have access to fewer financial incentives to replace their equipment early. In many cases, the new codes require more expensive equipment, which extends the payback period or reduces the ROI. In those early replacement cases, the end users are more inclined to maintain the old equipment rather than investing in newer, more efficient equipment; several contractors mentioned this is a meaningful barrier to deeper adoption of energy efficiency. In replace-on-burnout situations, the end user has no choice except to implement a more efficient unit that meets code. In these cases, the financial incentive is less relevant unless it encourages purchase of equipment that further exceeds the new code; PSE incentives are available for end users that decide to exceed code with their new equipment purchase. Section 2.2.2.2 includes further discussion about the ways in which contractors expect codes and standards to shape the market.

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[13] All information about this incentive originated from the Database of State Incentives for Renewables and Efficiency. November 2010. "Energy-Efficient Commercial Buildings Tax Deduction." Available: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US40F&re=1&ee=1

[14] Governor Chris Gregoire. June 10, 2010. "$100 Million Now Available for School Energy, Operational Improvements." Available: http://www.governor.wa.gov/news/news-view.asp?pressRelease=1514&newsType=1

[15] Washington State Department of Commerce. July 2010. "Jobs Act for K-12 Public Schools and Higher Education Institutions." Available: http://www.commerce.wa.gov/DesktopModules/CTEDPublications/CTEDPublicationsView.aspx?tabID=0&ItemID=8769&MId=884&wversion=Staging

[16] Database of State Incentives for Renewables and Efficiency. March 2011. "Energy Efficiency Resource Standard." Available: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=WA20R&re=1&ee=1

BUSINESS STRATEGIES

Business strategies provide the broader context in which organizational decisions about energy efficiency are made. Business strategies consider the market context, including policies, competition, investor expectations, and customer values. The approach that executives use to set business strategies varies from one company to the next. While the highest-level corporate policies are driven by forces that affect entire industries, the most effective corporate policies allow flexibility for local decision makers to adapt to the local context. A company's geographic reach, leadership philosophy, and corporate structure typically have the most impact; the organizations in PSE's territory exhibit much diversity in each of these characteristics. Despite this diversity, several common themes emerged related to the effect of business strategy on energy efficiency investment decisions.

Interviewed service providers perceive only one fundamental change in business strategy that is not directly related to the recent economic downturn. Contractors consistently indicate that organizations' **focus on "green" business**[17] plays a major role in energy efficiency investment decisions. Organizations in both the public and private sectors use their green practices in their messaging to the public to assert a competitive advantage. The goal of these communications can include building a positive brand image, offsetting other negative public relations issues (e.g., teacher layoffs), or directly attracting customers. In some cases, certain purchasers, such as Wal-Mart, have required the adoption of green practices among their suppliers.[18] Energy efficiency can play a key role for businesses that pursue the green image or business model.

Contractors consistently indicate that organizations' **focus on "green" business**[1] plays a major role in energy efficiency investment decisions.

All of the remaining findings about business strategy relate to the economic downturn, which has fundamentally reshaped economic activity worldwide. Many of these issues favorably affected energy investment decisions in PSE's service territory, but a few significant ones continue to prevent investments in energy efficiency.

Across the board, **efforts to cut costs** drive investment in energy efficiency among C&I customers. In the public sector, decreased tax revenues have led **public sector** entities to look for opportunities to reduce costs from non-personnel categories, including energy usage. [19] In parallel, public sector entities have deferred maintenance commitments in order to meet budgetary constraints, resulting in the need to

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[17] Organizations use the term "green" to mean greenhouse gas (GHG) emission reductions, environmental sustainability, or some other variation on this theme.

[18] Bustillo, M. July 17, 2009. "Wal-Mart to Assign New 'Green' Ratings." *Wall Street Journal.* Available: http://online.wsj.com/article/SB124766892562645475.html

[19] Senator Barbara Boxer. March 30, 2011. "Joint Full Committee and Subcommittee on Oversight Hearing GSA: Opportunities to Cut Costs, Improve Energy Performance,
and Eliminate Waste".
http://epw.senate.gov/public/index.cfm?FuseAction=PressRoom.PressReleases&ContentRecord_id=0753fb73-802a-23ad-4cec-7324dca60613&IsPrint=true

replace some equipment that is in sub-optimal operating condition.[20] Combined, these trends have contributed to opportunities for energy efficiency investment in the public sector.

In the **private sector**, cost reduction has provided an alternative approach to earning profit during a time when revenues have fallen in many industries.[21] Reductions in fixed costs became necessary when private firms exhausted opportunities to reduce variable costs; historically, many firms considered energy a fixed cost.[22] To meet aggressive cost-cutting targets, contractors report that some companies have adopted corporate mandates to reduce energy use. Investments in energy efficiency help companies to achieve those targets.

On the other hand, the uncertain economic climate has also resulted in business strategies that have negatively impacted investments in energy efficiency. Companies have been more averse to investments in areas **outside of their core competencies**. These non-core investments are seen as higher risk because the firm has less familiarity with the technologies, investment strategies, and long-term impacts of the non-core opportunities. As a result, many companies have decided to focus their limited capital resources on investments that will add value to their core business. Most firms consider energy efficiency outside of their core competencies.

PEOPLE

The people involved in energy efficiency investments have direct impact on the investment decisions and implementation logistics. The most effective projects involve champions within the host organization. These individuals use their credibility with internal decision makers and knowledge of decision-making processes to drive the project through the necessary internal channels. While contractors did not mention these types of champions as key drivers, previous research has documented their role.[23]

On the contrary, service providers report that many individuals at the **leadership level lack familiarity** with energy efficiency. In many cases, leadership does not understand the more efficient technologies, the options for paying for the projects, or the near- or long-term implications of the investment. Service providers must spend additional time during the sales process to provide these individuals with the information that they need to feel comfortable with the investment; in many cases, these interactions come after an initial point of contact (e.g., the facilities manager) has bought into the project. The additional education extends the sales cycle if the executives are open to it and can result in a rejected project if decision makers are not willing to learn.

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[20] See, for example: Thurston County (WA) Development Services Department. August 2010. *Supplement to the Thurston County, WA, Draft Capital Facilities Plan 2011-2016.* Available: http://www.co.thurston.wa.us/planning/cap-facilities-plan/docs/Supplement-2011-2016-2.PDFhttp://www.co.thurston.wa.us/planning/cap-facilities-plan/docs/Supplement-2011-2016-2.PDF or U.S. Department of Labor. November 2009. *Annual Report, Fiscal Year 2009: Performance and Accountability Report.* Available: http://www.dol.gov/_sec/media/reports/annual2009/RSI.htm

[21] Vigna, P. and J. Shipman. July 19, 2010. "Profits Up But Consumers Struggle." *Wall Street Journal.* Available: http://online.wsj.com/article/SB10001424052748704682604575369352459282906.html

[22] Marsan, C.D. July 7, 2008. "Under Pressure: 10 Sources Pushing CIOs to Go Green." *Network World.* Available: http://www.networkworld.com/news/2008/070708-green-cios-pressure.html

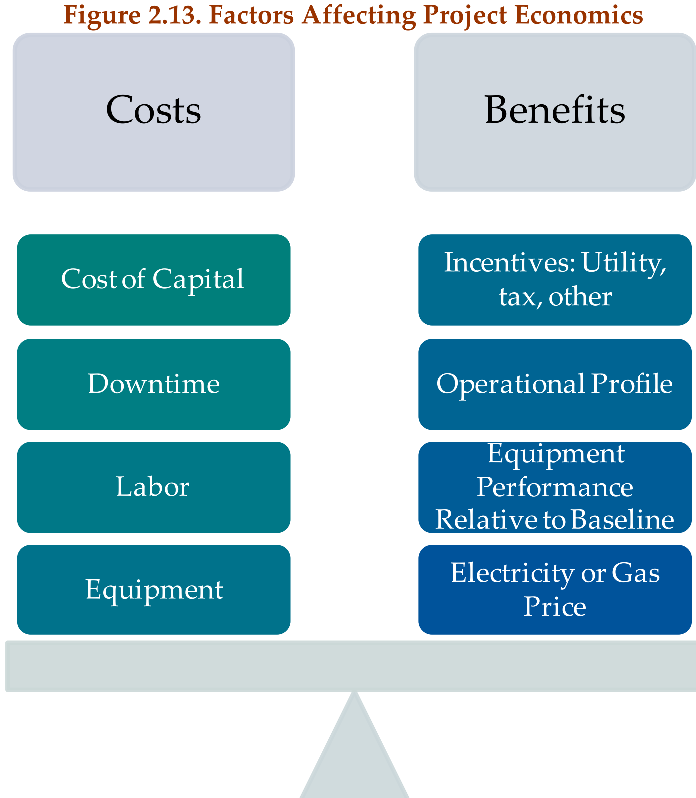
[23] U.S. Environmental Protection Agency (EPA)."Sector Collaborative on Energy Efficiency Accomplishments and Next Steps". July 2008. Available: http://www.epa.gov/cleanenergy/documents/suca/sector_collaborative.pdf

The **availability of trained staff** to assist with project implementation and ongoing maintenance also adversely affects energy efficiency decisions. In some cases, available staff is not familiar with the new equipment and require additional training to increase the likelihood of long-term success; the additional resources required to meet this training need can slow down or cancel a project. In other cases, staff is simply not available to assist because many organizations are operating with very lean staff resources due to the economic downturn.

PROJECT ECONOMICS

Cost-effectiveness, the final component that determines an energy efficiency project's success or failure, was cited most often by service providers as a determinant in project acceptance. If all of the other policies, business strategies, and people are aligned, the project economics will drive the final decision. Some companies measure this bottom line by measuring the ROI, while others measure the simple payback of the project. Either way, the key inputs to the project economics remain similar, as outlined in Figure 2.13.

Figure 2.13. Factors Affecting Project Economics



Source: Navigant analysis 2011.

The **cost of capital** has been the key cost consideration over the past three years. Capital has been constrained by the economic crisis as corporate balance sheets have weakened and investors' risk tolerance has declined, especially in response to concerns about firms' solvency. In some cases, this has manifested itself in higher interest rates charged by lenders; in other cases, it has resulted in companies' expectations of shorter payback periods for investments. As a result, energy efficiency is competing with a wide range of other investment opportunities for a smaller pool of capital. In many cases, the capital is simply not available to invest in energy efficiency after the firm selects its core business investments.

PSE's incentives have played an important role in alleviating some of this pressure during the economic downturn according to contractors. Depending on the project, the PSE incentive can provide an immediate 100 percent ROI by matching the funds committed by the organization. Further, they can help bridge the gap between an organization's available resources and the cost of the project. They have served a vital role in many projects, according to the contractors interviewed. Many contractors mentioned that it was difficult to compete on competitively bid jobs without the PSE incentive included as part of their package because it reduced the effective cost to the customer so significantly.

In some cases, contractors mentioned customers' **expectations about increasing energy prices** as a driver to invest in energy efficiency. Although energy prices in the Northwest remain low relative to other parts of the country[24], some customers express concern that they will increase in the future. An increase in electricity price makes energy efficiency projects more attractive; it can increase the ROI or decrease the payback time when included in a financial analysis. In this context, energy efficiency becomes a risk mitigation strategy, which can elevate it further in the eyes of business decision makers.

The costs associated with **business interruption** can sometimes trump any favorable opportunities caused by a low cost of capital, expectations about increasing energy prices, or the availability of PSE incentives. One contractor indicated that a single hour of downtime could cost some high-tech manufacturing firms $10 million. That is a major hurdle to overcome in the calculation of ROI or simple payback.

2.2.2.2 Changing Codes and Standards

Codes and standards that affect the market for commercial energy efficiency fall into two general categories: federal equipment and appliance standards and state and local building codes. Federal equipment standards for commercial buildings are based on the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1, which is updated every three years.[25] Following adoption of the updated ASHRAE Standard 90.1, the Department of Energy (DOE) undertakes a formal rulemaking to determine specific updates to existing codes and standards for each type of equipment.

Once new federal standards have been adopted, responsible state agencies must review them to determine whether their own state-level building codes require updates. State building codes must, at a minimum, match the federal requirements; however, states may choose to adopt codes that are more stringent in some areas. Rather than simply adopting the ASHRAE Standard 90.1, many states use an amended version of the International Energy Conservation Code (IECC).[26] The IECC is a model code historically used by state and local governments to regulate commercial buildings. Subsequently,

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[24] U.S. Energy Information Administration. "Table 5.6.A. Average Retail Price of Electricity to Ultimate Customer by End-Use, by State."Available: http://www.eia.gov/cneaf/electricity/epm/epm_sum.html

[25] U.S. DOE. 2011. "About the Building Energy Codes Program." Available at: http://www.energycodes.gov/about/. Accessed May 27, 2011.

[26] Conover, D., et al. 2009. "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings." Pacific Northwest National Laboratory.

municipalities (e.g., the City of Seattle) may adopt or amend the updated state building code to address local requirements or regulations.

Washington's non-residential energy code, contained in the Washington Administrative Code, is more stringent than federal standards.[27] However, while relatively progressive, Washington's energy code allows a building owner to exempt equipment or systems from certain requirements if they are shown to be economically unviable.[28]

Interviewed service providers demonstrated moderate levels of both awareness and concern regarding upcoming changes to codes and standards that will likely affect their businesses. Speaking generally about tougher code requirements, service providers pointed to increased costs, contractors cutting corners, and delayed equipment replacements as potential drawbacks.

» One interviewee estimated that some recent code changes have added 40 percent to the cost of changing a particular piece of equipment. He suggested this can create a perverse incentive for contractors to complete work without proper permits (and give them an unfair advantage over firms unwilling to bend the rules).

» Another interviewee cited utilities' tendency to only incentivize projects that *exceed* already stringent efficiency-related standard (rather than those that simply meet code).[29] He commented that this effectively increases a customer's cost for early replacement of a piece of inefficient equipment. Rather than spending extra money in order to qualify for the utility incentive and retire the equipment early, building operators may wait for the equipment to fail.

Despite such concerns, service providers also expressed support for the benefits of recent and upcoming energy code requirements. In particular, the added transparency in energy savings that stems from requirements to monitor buildings or individual pieces of equipment can encourage more energy end users to implement energy efficiency retrofits.

An in-depth discussion of changing codes and standards for every type and size of equipment is beyond the scope of this study. Instead, the remainder of this section summarizes specific code and standard changes (at both the federal and state levels) that service providers specifically suggested were likely to affect their business in the next five years.

LIGHTING

One of the more significant upcoming changes to federal standards involves **the phase out of less efficient fluorescent lamps.** Beginning in July 2012, general service four-foot linear fluorescent lamps

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[27] Non-residential code in Washington is as stringent as ASHRAE 2007 as of January 2011 (http://www.energycodes.gov/states/state_info.php?stateAB=WA). Comparatively, the federal code requires compliance with the older ASHRAE 2004 (http://www.energycodes.gov/federal/).

[28] Interview with Chuck Murray, Energy Policy Specialist, Department of Commerce, Washington State Energy Office. May 25, 2011.

[29] In cases in which operable equipment is replaced early, PSE's C&I retrofit program bases its incentive calculation on the assumption that the existing equipment is considered baseline. The new equipment must meet code at a minimum, but it is not required to exceed code in order to receive an incentive. This appears to be a point of confusion for some trade allies.

will be required to meet a minimum efficiency of 89 lumens per Watt. This standard will effectively limit the sale of linear fluorescent lamps to (at a minimum) high-performance T8 lamps, and will prohibit the sale of less efficient T12 and standard T8 lamps (e.g., first generation 700-series).[30] Subsequently, beginning in 2014, federal standards will also prohibit standard T8 ballasts, providing additional energy savings from high-performance T8 ballasts.

Some interviewed equipment suppliers are already phasing out their stock of equipment that will no longer meet requirements in 2012 (e.g., 700-series fluorescents and T12s). In anticipation of these changes, many remodel, tenant improvement, or replace-on-burnout projects will likely be designed to meet the stricter code requirements by using high-performance T8 ballasts, even without utility incentives. However, PSE may continue to offer incentives to encourage the early replacement of lighting equipment among potential retrofit customers who would otherwise wait for the need to remodel or for their equipment to burnout.[31]

For state-level code changes, several service providers cited the recently implemented **requirements for lighting controls and daylight harvesting** in Washington's Non-Residential Energy Code (NREC).[32] State code requires the installation of automatic daylight sensing controls in all areas with skylights and windows, as well as automatic shut-off controls for most interior lighting applications.[33] One respondent expressed concern that these sensors would inhibit project ROIs as a result of both increased equipment costs and reduced savings from lighting retrofits (since improved controls mean fewer operating hours and savings opportunities per fixture). However, another service provider expressed satisfaction knowing that the expertise necessary to help customers meet the new requirements would eliminate less-experienced contractors that have recently flooded the lighting retrofit market.

Motors

In December 2010, the federal government implemented **higher efficiency standards for general purpose motors** up to 200 horsepower, and extended efficiency standards to special purpose motors that were not previously covered under federal efficiency standards.[34] These standards affect both process equipment (e.g., compressors and conveyors) as well as HVAC equipment. As with lighting equipment, manufacturers and distributors reported that they began phasing out motors that would not meet the new efficiency specifications well before the rule took effect. Despite the decreasing availability of less efficient units to replace burnt-out equipment, utility incentives can continue to encourage early replacements as end users search for energy savings and reductions in operating costs.

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[30] Cooney, K. and R. Maslowski. Navigant Consulting. 2011. "Commercial Lighting Market Transformation Model Development and Market Research – Phase I: T12 Retrofit Market. (Review Draft)" Energy Trust of Oregon.

[31] Starting in July 2012, when a customer with a standard T8 fixture has the lamp burnout, they will have to replace the lamp with a high performance T8. However, this will not produce any energy savings, as high-performance T8 lamps have the same wattage as a standard T8 lamp. With a standard T8 ballast as the baseline, the opportunity for code-driven energy savings will occur in 2014 when high-performance ballasts will replace standard T8 ballasts.

[32] Washington Administrative Code 51-11-1513. (http://apps.leg.wa.gov/wac/default.aspx?cite=51-11-1513)

[33] Lane, M., et al. 2010. "2009 Washington State Non-Residential Energy Code: Lighting and Energy Metering Webinar". Northwest Energy Efficiency Council.

[34] US DOE. 2011. "Appliances & Commercial Equipment Standards: Electric Motors." Accessed May 27, 2011. Available at: http://www1.eere.energy.gov/buildings/appliance_standards/commercial/electric_motors.html

None of the suppliers mentioned this issue in a negative light; rather, one interviewee suggested that the standards had actually helped his company streamline their product lines and offerings. With many products already available at the improved efficiency requirements, the new standards may have simply eliminated lower tier equipment. The interviewed suppliers did not mention any anticipation of state-level codes related to motors or HVAC equipment having a significant impact on their business.

COMMERCIAL REFRIGERATION

Until recently, no federal efficiency standards existed for commercial refrigeration equipment. The first federal standards to go into effect for commercial refrigeration equipment were prescribed by the Energy Policy Act of 2005 (EPACT 2005), which had a compliance date of January 1, 2010. In addition, EPACT 2005 required the DOE to conduct an energy conservation rulemaking for other types of commercial refrigeration equipment. This second set of standards was published in January 2009, and will take effect on January 1, 2012.[35]

The 2009 final rule standards will result in substantial energy savings, and interviewed equipment manufacturers indicated that they have already begun to produce more energy efficient equipment. However, a great deal of uncertainty remains regarding DOE's rules for certification, compliance, and enforcement of the EPACT 2005 and 2009 final rule. In its rulemaking on certification, compliance and enforcement, the DOE used a basic-model approach to certifying that equipment meets the standards; however, most commercial refrigeration equipment is customized to meet each end user's needs. To the degree that such customization causes a piece of equipment to fall outside of the basic-model parameters, the manufacturer could be required to perform extensive tests to confirm its energy performance meets the DOE's requirements. Such uncertainty could create uneasiness and additional costs for manufacturers.

With regulation of this equipment occurring only in the past few years, the initial standards required may have left substantial room for future improvement. Incremental strengthening of the standards may occur due to planned review of the EPACT 2005 and 2009 DOE final rule standards. The first of these reviews is scheduled for 2013, with another being mandated by legislation in 2016.[36] In the near-term, this could leave an opportunity for utilities to incentivize above-code equipment that can achieve significant energy savings.

METERING

Service providers also specifically mentioned Washington State's new requirements related to energy metering. The 2009 NREC requires the metering of energy usage data from building energy supply sources (e.g., grid-supplied or on-site generation) and various energy consuming equipment. Table 2-4 lists the system sizes and capacities above which equipment must have an independent submeter installed. This requirement applies to both new construction and the replacement of existing building systems.[37]

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[35] US DOE. 2011. "Appliances & Commercial Equipment Standards: Commercial Refrigeration Equipment." Accessed May 27, 2011. Available at:
http://www1.eere.energy.gov/buildings/appliance_standards/commercial/refrigeration_equipment.html.

[36] US DOE. 2011.

[37] Lane, M., et al. 2010. "2009 Washington State Non-Residential Energy Code: Lighting and Energy Metering Webinar". Northwest Energy Efficiency Council.

Table 2-4. Size Thresholds for Washington NREC Submetering Requirements

Category	Submetering Threshold
Chillers/heat pump systems	> 70 kW (240,000 Btu/h) cooling capacity
Packaged AC unit systems	> 70 kW (240,000 Btu/h) cooling capacity
HVAC fan systems	> 15 kW (20 hp)
Exhaust fan systems	> 15 kW (20 hp)
Make-up air fan systems	> 15 kW (20 hp)
Pump systems	> 15 kW (20 hp)
Cooling towers systems	> 15 kW (20 hp)
Boilers, furnaces and other heating equipment systems	> 300 kW (1,000,000 Btu/h) heating capacity
General lighting circuits	> 15 kVA
Miscellaneous electric loads	> 15 kVA

Source: NEEC 2010. Washington State Non-Residential Energy Code Webcast

Service providers generally discussed this new requirement in a favorable light, acknowledging that it will make building owners more apt to save energy if they can see the results of the money they spend. From PSE's perspective, this new requirement may lend itself to the measurement and verification of incentivized systems and equipment.

SEATTLE'S BUILDING MONITORING ORDINANCE

The benefits of increased transparency of energy savings were also cited in service providers' discussions about the City of Seattle's building energy benchmarking and reporting ordinance. In 2010, the City of Seattle adopted a resolution requiring energy disclosure for non-residential buildings. Buildings over 50,000 square feet must benchmark and report their facilities' energy performance to potential buyers, lenders, lessees, and the City by October 2011 (originally April 2011); buildings over 10,000 square feet must start reporting by April 2012.[38] Again, while the requirement will add additional costs for building owners and property managers, the net effects of increased visibility and awareness are likely to increase overall energy savings.

While this mandate will primarily affect electricity use and savings for Seattle City Light customers, many also receive gas service from PSE. In addition, a similar benchmarking requirement adopted in New York City suggests that spillover effects of such mandates (e.g., improved access to and interest in energy benchmarking resources and tools) may drive additional energy savings in the region as a whole.[39] As ESCOs and other service providers improve their building monitoring and benchmarking capabilities in response to the City of Seattle's requirement, they can offer those expanded services in surrounding municipalities. Such offerings may attract particular interest from commercial building

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[38] City of Seattle Department of Planning and Development. 2011. "Our Program: Energy Benchmarking and Reporting." http://www.seattle.gov/dpd/GreenBuilding/OurProgram/PublicPolicyInitiatives/DPDP018682.asp

[39] Lowenberger, A., et al. 2010. "What Drives Energy Performance Scores: Benchmarking NYC High Rise Building Stock." 2010 ACEEE Summer Study on Energy Efficiency in Buildings.

owners in cities surrounding Seattle, who compete for the same building tenants that may consider locating in the greater metropolitan area.

2.2.2.3 High-Impact Technologies on Fast Growth Curves

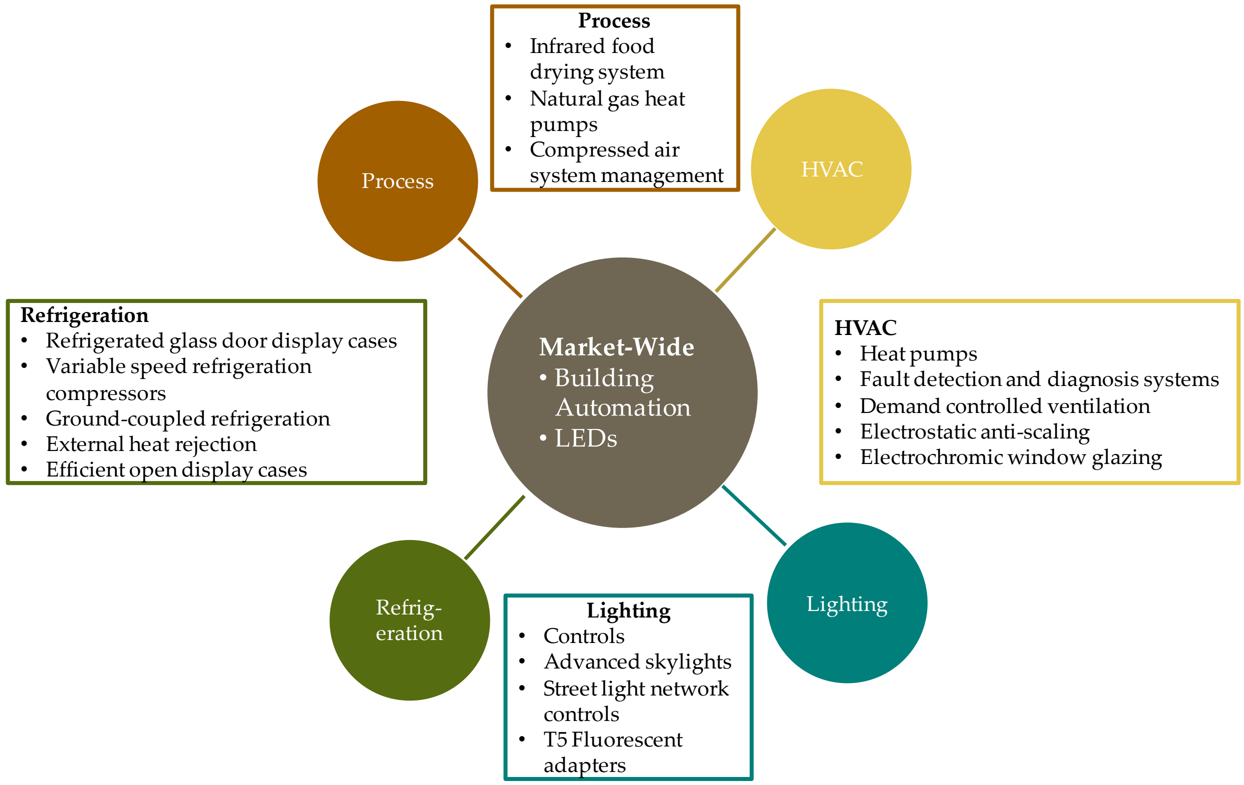
Market actors anticipate that two key technology trends will have the most significant effects on the market for energy efficiency in the next two to five years: building automation and light emitting diodes (LEDs). These technologies are already commercially available, but certain barriers have inhibited widespread adoption to date, most prominently in the case of LEDs. Several market actors have indicated that those barriers have diminished in recent months and will continue to decrease in the near term.

In addition, a broader screening of high-impact technologies in the priority technology sectors indicates that other technologies have the potential to affect the market in the next two to five years. Market actors mentioned several of these technologies during the interviews, but the technologies did not garner as much widespread market recognition as building automation and LEDs. As a result, these are discussed at a higher level in this section.

This section provides an overview of the technologies that are anticipated to affect the market for C&I energy efficiency most significantly in the next two to five years. It begins with a closer look at building automation and LEDs. The last part of this section provides an overview of other technologies in the lighting, HVAC, refrigeration, process, and heat recovery categories that also have potential to make an impact in the next two to five years. The main body of the report covers these technologies at a high level; additional detail on these second-tier technologies is available in Appendix D.

Figure 2.14 summarizes the technologies identified by Navigant.

Figure 2.14. Overview of High-Impact Technologies on Fast Growth Curves



Source: Navigant analysis 2011.

Building Automation

The value proposition for building automation has grown substantially in the past few years. As "smart grid" technologies have evolved to leverage accelerated developments in information technology, building owners have become more aware of the opportunities to control aspects of building operations from remote location.

Building automation systems incorporate a wide variety of controls. Many of these controls relate directly to energy efficiency:

» Occupancy sensors provide fundamental information to drive energy savings in buildings. Using occupancy sensors, automation systems can reduce energy use in unoccupied spaces for many loads, including lighting, HVAC, vending machines (refrigeration and lighting) and more.[40]

» Lighting sensors (photocells) monitor ambient light levels, allowing for modulation of artificial light sources. Many areas of buildings have sufficient daylight from skylights and windows; by monitoring light levels, automation systems can reduce artificial lighting without impacting occupant comfort.

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[40] Reliant Energy: Vending Machine Energy Savings. Available: http://www.reliant.com/en_US/Page/Generic/Public/esc_purchasing_advisor_vending_machine_energy_savings_bus_gen.jsp

- HVAC controls, driven by a variety of sensors, reduce load by minimizing HVAC load based on occupancy, fresh air requirements, air temperature, and time of day.
- Carbon dioxide (CO_2) sensors offer an indirect form of occupancy sensing to directly determine the amount of outside air that needs to be introduced to each room by the ventilation system in order to meet fresh air requirements in building standards.

Outdoor air temperature and humidity sensors enable the use of HVAC economizers and boiler temperature modulation (outdoor temperature reset). Economizers entrain greater amounts of outdoor air when outdoor air demands lower energy consumption to condition than re-circulated air. When outdoor temperatures are moderate during heating season, boiler temperature modulation maintains occupant comfort while reducing losses.

Other controls may be only indirectly or not at all related to energy efficiency. For example, differential pressure switches on a filter can determine if it is dirty; this alarm provides benefits beyond energy efficiency (i.e., reduced downtime), but a clean filter also increases the efficiency of the system. In addition, building automation systems can control security and sprinkler systems, which have little to do with energy efficiency.

Building automation is gaining broader interest from building owners and ESCOs because it enables technicians to identify issues from a remote site. This enables decision makers to determine the most appropriate staff to deploy to address the issue without having to send out a generalist first; this reduces the number of person-hours and costs for troubleshooting. Further, ESCOs find value in building automation because they can determine reasons for sub-par energy performance, again without having to send staff to the site to investigate. For ESCOs that have signed performance contracts, this approach enables them to fix the problems faster and earn the returns on their investment faster.

LIGHT EMITTING DIODES (LEDS)

LED technology evolved rapidly in recent years. LEDs are highly coveted for their extended lifetime (as much as 50,000 hours in some applications), and their low energy consumption (up to 80 percent lower than incandescent bulbs).[41] One of the most important advances is in light quality; early products produced poor quality light that was uncomfortable and distracting for consumers. Newer products produce high-quality light and consistently perform close to their ratings.

Many niche applications and technologies are advancing ahead of the curve. Four such areas include the following: (1) exit signs, (2) bi-level parking area lamps, (3) street/area lighting, (4) refrigerated display cases, and (5) channel letter signage. Figure 2.15 shows some of these applications.

[41] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. "Lighting Choices." Available: http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=11975

Figure 2.15. Examples of Niche LED Applications

From Left (with Sources): Exit Signs (The Exit Store), Bi-Level parking lot lighting (California Emerging Technology Coordinating Council), Street/Area applications (Sacramento Municipal Utility District), Refrigerated Display Cases (Pacific Gas and Electric)

Of these, exit signs are the most common application today. Many utilities across the country provide incentives for LED channel-letter signage, typical on commercial storefronts.[42] High-use lighting applications, such as streetlights and parking lighting are other prime opportunities for LEDs. Because of the extended hours of use in these applications, owners will have shorter payback periods. For building owners with large quantities of fixtures, the significant reduction in maintenance costs due to infrequent replacement needs may be a major driver in selecting LED products.

Costs continue to decrease, but first-cost barriers continue to be the single largest challenge for LED lighting. For example, a typical commercial T8 LED lamp (17W-22W depending on the product) now costs $60 or more, whereas a conventional T8 lamp (28W) costs approximately $2.[43] These costs often force facility owners to evaluate other lighting options that may bring down the initial investment in exchange for less reduction in operation costs. At current prices, the lifetime cost savings do no outweigh the first cost barrier without financial incentives.

Many market actors expressed concern about the quality of LEDs in the marketplace over the past few years. The market was still immature, leading to an abundance of inexperienced or "fly-by-night" manufacturers of LEDs that produced products with questionable quality. Several service providers interviewed were reticent to sell unproven products to their customers due to concerns about their own credibility.

Many of these concerns have abated, however. LEDs are now available from credible vendors with long track records of producing reliable products (e.g., GE, Philips, Osram Sylvania). Most market actors interviewed for this project indicated that they are willing to suggest these products to their customers. One service provider specifically mentioned the adoption of an ENERGY STAR measurement for LEDs, and utilities' subsequent endorsement of that standard, as indicators that the technology has gained market acceptance.

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[42] Utilities with channel-letter signage rebates include SMUD, CPS Energy, Rocky Mountain Power, ComEd, PG&E, and others.

[43] Richman, et. al., "Laboratory Evaluation of LED T8 Replacement Lamp Products." Pacific Northwest National Laboratory. May 2011. Available: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/gateway_t8-replacement.pdf

OTHER TECHNOLOGIES THAT CAN IMPACT EE IN THE C&I SECTORS

A broader suite of technologies have the potential to achieve deeper energy efficiency gains in the next two to five years. While these technologies did not receive as much widespread recognition from contractors as building automation systems and LEDs did, Navigant expects they will mature and expand as widely available, cost-effective technologies within two to five years. The following tables present brief descriptions of the top technologies in each priority measure category. Appendix D includes additional detail on the top two technologies in each measure category.

Table 2-5. Promising Technologies: Lighting

Technology	Description
LEDs	LED technology reduces energy consumption by up to 75% over equivalent incandescent bulbs.[44] First costs remain a barrier, but the technology continues to mature rapidly, and with maturity comes lower prices.
Controls	Lighting controls save energy by reducing lighting load based on occupancy, lighting levels, and/or time of day. Integration of individual components into comprehensive controls and automation systems provide the highest levels of savings.
Advanced skylights, including solar tracking	Advanced skylights introduce greater amounts of sunlight into interior building spaces using the same skylight surface area, thereby reducing artificial lighting needs.
Street light network controls	Street light networking and remote monitoring provides savings by using dimming capabilities to set appropriate lighting levels, and by ensuring that lights are not lit inadvertently during daylight hours.
T5 Fluorescent adapters	T5 adapters allow existing ballasts (for T-12 (40W) or T-8 (32W)) to drive new low-profile T-5 (28-W) lamps without expensive retrofit installations. Some, like Retrolux, also provide wireless-driven dimming capabilities.

Source: Navigant analysis 2011.

[44] ENERGY STAR: Why Choose ENERGY STAR Qualified LED Lighting? Available: http://www.energystar.gov/index.cfm?c=ssl.pr_why_es_com

Table 2-6. Promising Technologies: HVAC

Technology	Description
Heat pumps	Ground-coupled heat pump systems consist of a hydronic loop for exchanging thermal energy between the ground and one or more end uses, including space heating/cooling, or water heating. The earth is an infinite heat sink/source that enables higher operating efficiencies than typical air-source heat pumps.
Fault detection and diagnosis systems (FDD)	FDD systems monitor equipment operation and notify users of faults or performance degradation. Such operational transparency helps avoid catastrophic failures by enabling corrections as soon as issues arise.
Demand controlled ventilation	Occupancy-based ventilation reduces space conditioning loads by reducing the amount of outdoor air that the system entrains (while maintaining minimum requirements).
Electrostatic anti-scaling	Electrostatic anti-scaling uses an electromagnetic process to mitigate fouling of chiller condensing tubes. This process increases energy efficiency, reduces water consumption and eliminates expensive chemical treatments that contaminate the water.
Electrochromic window glazing	Electrochromic glazing uses small electrical currents to dynamically change a window's thermal, solar and visible transmittances. Such adjustments alter heat gain in the building and therefore reduce heating and cooling loads.
Other technologies mentioned by market actors: ice storage systems for cooling[45] and digital screw compressors.	

Source: Navigant analysis 2011.

[45] Such systems use off-peak electricity (typically at night) to produce ice, which is subsequently used in lieu of conventional (and more energy intensive) air cooling methods during peak usage hours (e.g., late afternoon).

Table 2-7. Promising Technologies: Refrigeration

Technology	Description
High efficiency, refrigerated glass door display cases	New glass door display cases reduce refrigeration load in supermarkets and convenience stores. As a retrofit option for open cases, these units also reduce space conditioning loads.
Variable speed refrigeration compressors	Variable speed drive (VSD) used in industrial, high-load applications has proven the energy savings potential by allowing for load matching modulation. VSDs have significant room for increased penetration in refrigeration applications.
Ground-coupled supermarket refrigeration	Much like geothermal (ground-source) heat pumps, ground-coupled supermarket refrigeration uses the ground as an efficient heat sink for the vapor compression system, thereby improving system efficiency, especially on hot days.
External heat rejection for walk-in coolers and freezers	Many small commercial refrigeration systems reject heat within the conditioned space of the building, resulting in increased cooling loads.
Efficient open display cases	New, high-efficiency display cases reduce refrigeration load by reducing warm-air infiltration and optimizing suction pressure. New cases reduce infiltration through turbulence reductions in return air grills, and with advanced air curtains, which are precisely directed air currents that create a barrier across the case's open side.

Source: Navigant analysis 2011.

Table 2-8. Promising Technologies: Process

Technology	Description
Food drying – infrared and high efficiency gas system	Electric infrared (IR), or newer flameless catalytic IR dryers use IR radiation to dry food. IR drying eliminates the inefficiency of transferring heat to air and from the air to the wet material. New gas-driven steam dryers also provide significant savings over conventional units.
Natural gas heat pumps for process heating and cooling	Thermally driven heat pumps use natural gas to either (1) power a natural gas engine-compressor in a vapor-compression cycle, or (2) run an absorption process. Since heat pumps inherently provide simultaneous heating and cooling, they are uniquely positioned to fill this need in many industrial processes.
Compressed air system management	Compressed air management systems monitor and improve compressor performance by balancing compressor network loads, optimizing cycling, and regulating output pressure. The technology is also applicable to other HVAC-R compressors.

Source: Navigant analysis 2011.

Table 2-9. Promising Technologies: Heat Recovery

Technology	Description
Organic Rankine Cycle	Organic Rankine Cycle systems generate electricity from low-grade waste heat streams. These systems benefit where heat sources are insufficient to drive superheated steam turbines.
Commercial desuperheaters for vapor compression systems	Desuperheaters use rejected heat in a vapor compression cooling/refrigeration system to heat water. They displace water heating loads and also improve cooling system efficiency.
Dimpled tube heat exchanger	Dimpled tube technology improves the thermal efficiency in a variety of industrial heat exchangers by introducing a vortex within each dimple to intensify convective heat transfer. Additionally, this technology mitigates heat exchanger fouling.
Transport membrane condenser	Transport membrane condensers enhance the capture of waste heat and water vapor from exhaust/flue gas for reuse. This technology can be applied to a wide variety of industrial, commercial, and residential equipment.
Industrial water recycling	Industrial water recycling typically uses microfiltration to remove dissolved and suspended solids so that water can be reused. The water maintains its temperature, saving water heating energy. Applications include laundries, food processing, textiles, and any other water-intensive applications.

Source: Navigant analysis 2011.

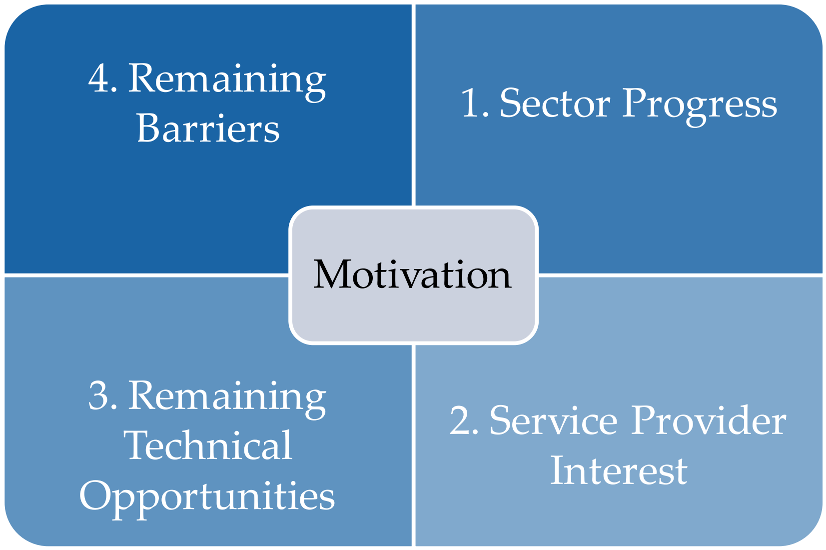
2.2.3 Recent Developments in Key Market Sectors

This section provides an overview of the current status of each of the four key market sectors. Sections 2.2.1 and 2.2.2 outlined the market conditions that affect all of these market sectors, but each sector is unique in some way. Whether it is the split incentives in the office sector or the seasonal nature of food processors' operations, program managers and staff can incorporate these sector-specific nuances into their approach to the sector.

As shown in Figure 2.16, each of the following four subsections describes the factors that influences customer to act in each of the target sectors; each section also outlines the factors that prevent the customer from taking further action. Each of these sections follows the same structure:

- Motivation to Pursue Energy Efficiency: the unique factors that lead the sector to incorporate energy efficiency into their operations
- Sector Progress towards Energy Efficiency: developments in the sector that have prepared the sector for PSE's engagement and incentives
- Service Provider Interest in the Sector: the extent to which companies have identified these sectors as prime candidates for energy efficiency investments
- Remaining Technical Opportunities: measure categories that have not yet been exhausted, according to market actors interviewed
- Remaining Barriers: the challenges that prevent the sector from fully embracing energy efficiency

Figure 2.16. Structure of Sector-Specific Sub-Sections



Source: Navigant analysis of market actor interviews 2011.

These discussions rely on market actor input rather than on facility-specific data. Additional detail on the baseline equipment typical of these sectors regionally is available in NEEA's 2009 *Northwest Commercial Building Stock Assessment*.[46]

2.2.3.1 Offices

PSE's DSM potential study identified office facilities as the single largest targeted opportunity for achievable energy savings potential for both electricity and gas. Only the "Other" buildings category had larger potential in the gas study. Similarly, NEEA's 2009 *Northwest Commercial Building Stock Assessment* reveals that office buildings account for the single greatest share of floor space (19 percent) in the Northwest.[47] This section outlines the findings for the office sector.

KEY CHARACTERISTICS OF OFFICE SECTOR FACILITIES IN PSE SERVICE TERRITORY

The project team surveyed representatives of 22 office sector facilities in PSE service territory. A list of participants in PSE's G205 and E250 programs during the past two years served as the starting point for selecting facilities for the sample frame. Navigant eliminated all records that had "Business Type" different than Office, Office and Warehouse, and Office and Manufacturing. The remaining list of facilities represented facilities that were not included in the Process or Impact Evaluation samples that are part of this project. Figure 2.17 includes all of the facilities that were included in the population of potential survey respondents after the data cleaning was completed (black) as well as all of the facilities that responded to the survey (green).

[46] Cadmus Group. December 2009. *Northwest Commercial Building Stock Assessment.* Northwest Energy Efficiency Alliance.

[47] Cadmus Group. December 2009. *Northwest Commercial Building Stock Assessment.* Northwest Energy Efficiency Alliance.

» As shown in Figure 2.17 you will see Office Sector Population and Survey Respondents.
» As shown in Figure 2.18 through Figure 2.21, several characteristics of the food processing market segment indicate that it is a promising market for energy efficiency:
» The majority of the office sector facilities (73 percent) reported that they own and occupy their facilities, as shown in Figure 2.21. As in the case of food processing, these owner-occupied facilities have alignment between the financial goals of the party investing in energy efficiency and those of the party realizing the financial benefits.
» As shown in Figure 2.20, only half of the office sector facilities that were part of the survey indicated they plan to invest capital in their facilities in the next two years. Near-term energy efficiency investment opportunities are higher in the office sector than in the public sector but generally not that favorable.
» Office sector facilities vary in scale in terms of both facility size (Figure 2.18) and number of employees (Figure 2.19). Most of the facilities fall in the medium category in terms of facility size (10,001 – 50,000 sq. ft.). The majority of the facilities have a small number of employees (between 1 and 50 employees).
» Most of the largest office facilities that have previously participated in PSE programs are located in and around Bellevue in PSE's combined service territory as shown in Figure 2.22. The largest facilities in Seattle do not appear to have been reached by PSE's programs.

Figure 2.17. Office Sector Population and Survey Respondents

Source: Navigant analysis of E&W survey of PSE Customers 2011.

Figure 2.21. Owner-Occupancy Rate – Office Sector (n=22)

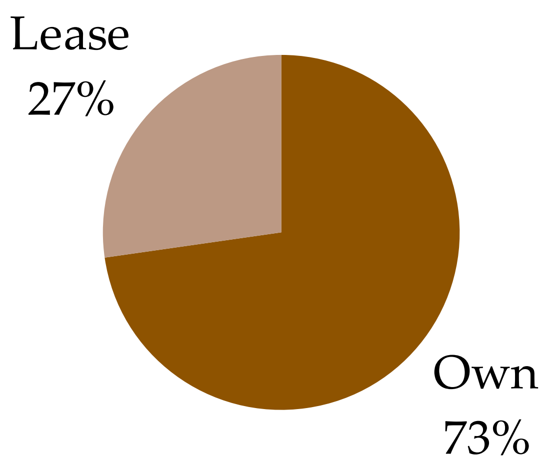


Figure 2.18. Facility Size – Office Sector (n=22)

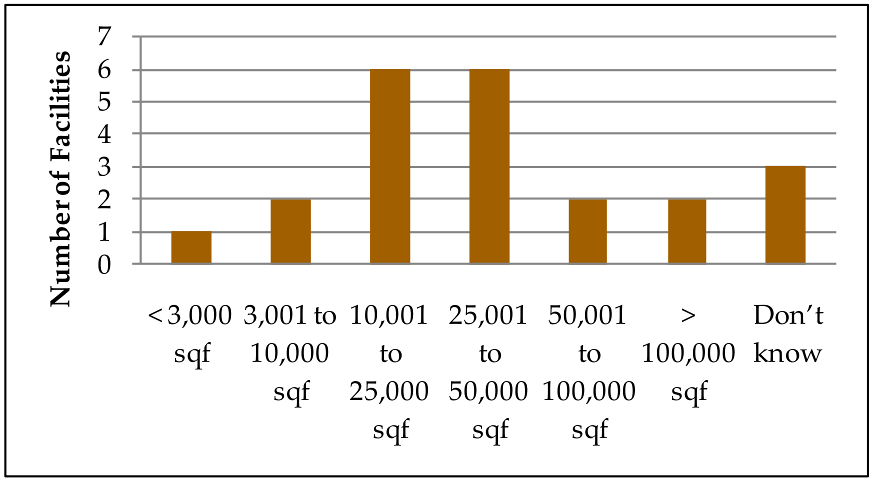


Figure 2.20. Planned Capital Spending in Next Two Years – Office Sector (n=22)

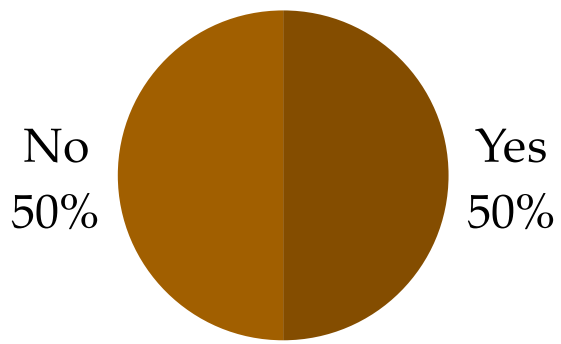
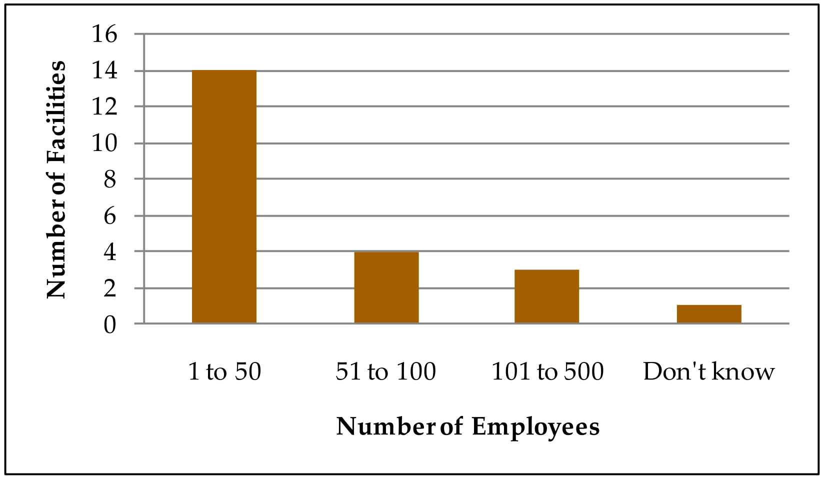
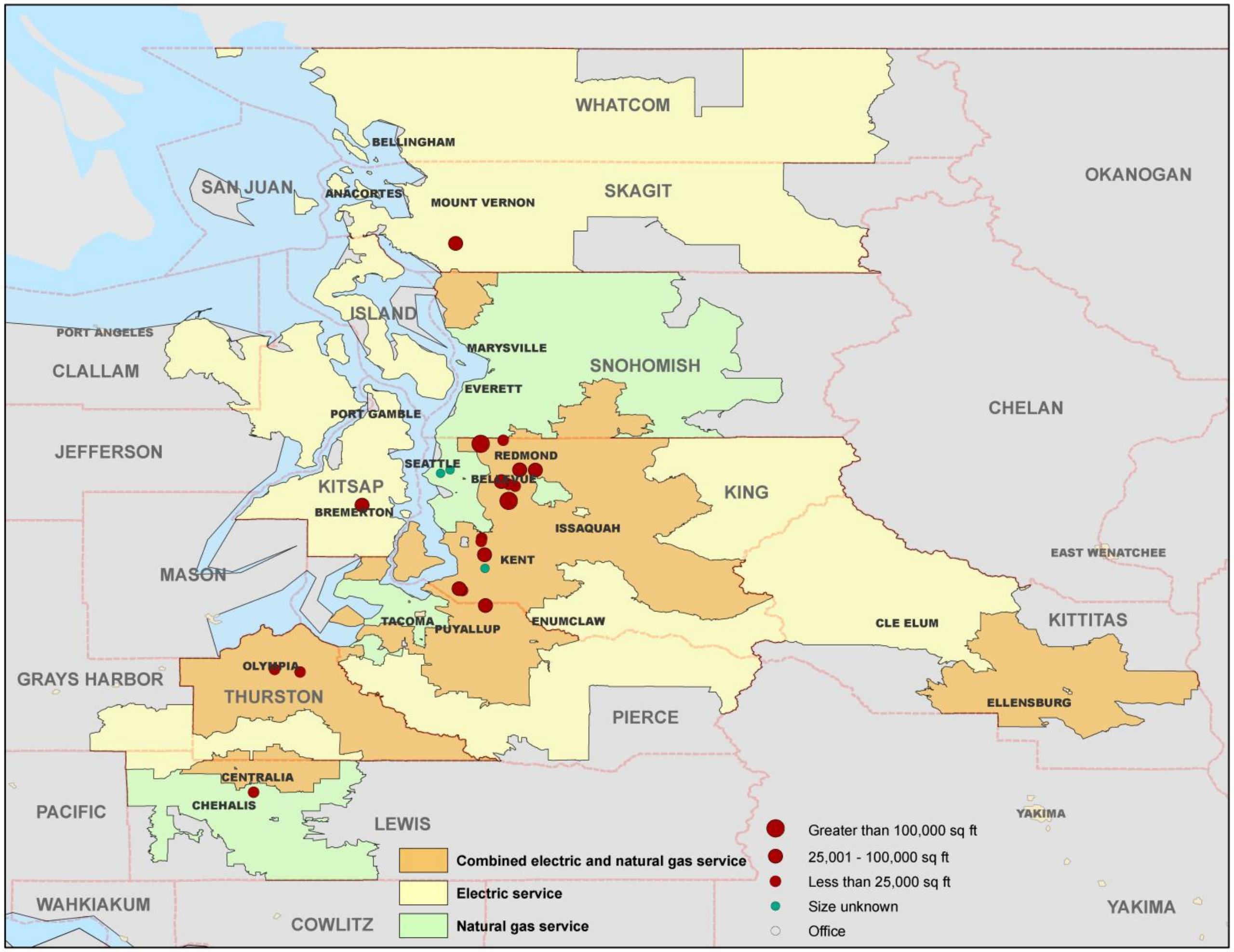


Figure 2.19. Number of Employees Per Facility – Office Sector (n=22)



Source for all figures on this page: Navigant and E&W Survey of Offices, 2011.

Figure 2.22. Office Sector Facility Size by Location



Source: Navigant analysis of E&W Survey of PSE Customers 2011.

MOTIVATION TO PURSUE ENERGY EFFICIENCY

The value proposition for office building owners to pursue energy efficiency has changed since the onset of the economic downturn. Office building owners have sought opportunities to increase the value of their properties amidst increasing vacancy rates and falling property values. Vacancy rates increased from 8 percent in late 2007[48] to over 20 percent in mid-2010.[49] As revenue from rent declined, office real estate values plunged by 46 percent in the Seattle area between the market's peak in the third quarter of 2008 and the end of 2010.[50] These trends created a very competitive market amongst property owners and managers as they sought to secure a limited pool of tenants.

In this very competitive environment, "green" office properties became a competitive advantage. Other competitive advantages typically sought after by property managers and owners (e.g., price, status, proximity to amenities, etc.) were ineffective since so many properties were available. Instead, buildings that could claim some type of "green" status in progressive Seattle saw an opportunity worth pursuing. Energy efficiency became part of that "green" package.

Energy efficiency improvements also helped increase property values by decreasing costs. Real estate properties are valued, in part, based on discounted values of the property's future net operating income.[51] By decreasing the costs associated with a particular property, the amount of positive cash flow to an owner (or potential owner) increases. This, in turn, increases the calculated value of the property. Since revenue growth was limited during the economic downturn, cost decreases became an important part of maintaining property values.

SECTOR PROGRESS TOWARDS ENERGY EFFICIENCY

NEEA helped support the office real estate market's interest in energy efficiency both before and during the economic downturn. Most recently, the BetterBricks program has focused on the office real estate market since 2006, including both new construction and building operations. NEEA has pursued a market transformation effort aimed at real estate managers by promoting the competitive advantages and increased profitability associated with high-performance building energy management. The program's key accomplishments include the following:

- Forming key partnerships and initiatives with regional industry market actors, particularly the Building Owners and Managers Association (BOMA) and the Urban Land Institute (ULI)
- Working with the energy efficiency services sector to identify and foster best practices in building operations and maintenance
- Developing tools and resources to assist building owners and facility managers in achieving building performance improvements (e.g., the *High Performance Portfolio Framework*)

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[48] Shevory, K. October 21, 2008. "Even in Resilient Seattle, Office Vacancy Rate Is Rising." *New York Times.* Available: http://www.nytimes.com/2008/10/22/business/22seattle.html?_r=1&8au&emc=au&oref=slogin

[49] Pryne, E. July 8, 2010. "Seattle Sees Increase in Occupied Office Space." *The Seattle Times.* Available: http://seattletimes.nwsource.com/html/businesstechnology/2012312547_office09.html

[50] Navigant Capital Advisors. 2010. *Quarterly Dialogue: Fourth Quarter 2010: Distressed Real Estate.* Available: http://www.navigant.com/~/media/Site/Insights/Corporate%20Finance/Distressed%20Real%20Estate%20Quarterly%20Dialogue%204Q10.ashx

[51] Jaffe, D. and R. Stanton and N. Wallace. November 30, 2010. *Energy Factors, Leasing Structure, and the Market Price for Office Buildings in the U.S.* Fischer Center for Real Estate and Urban Economics: University of California, Berkeley. Available: http://faculty.haas.berkeley.edu/ldavis/Enviro@Haas_files/JSW2010%5B1%5D.pdf

» Raising awareness of the links among energy efficiency, sustainability, and building owners' bottom line profitability[52]

NEEA has worked with market actors (including building owners, property managers, and industry associations) to begin reducing the primary barriers to energy efficiency in this sector. These collaborative efforts grew from NEEA's identification of the specific barriers to implementing energy efficiency projects in the office real estate sector (e.g., split incentives, renovation cycles). These efforts have focused largely on the transactional nature of commercial real estate (e.g., leases, underwriting) and the efficiency opportunities presented by best practices in building energy management and operations.

NEEA also helped established the state's Building Operator Certification (BOC) training initiative to achieve lasting improvement in the energy-efficient operation and maintenance (O&M) of commercial buildings.[53] Today, the Northwest Energy Efficiency Council (NEEC) and the International Building Operators Association (IBOA) continue to offer the training. BOMA promotes the training to its members. Participation remained steady or increased during the economic downturn, with more than 800 building operators earning the certification each year.[54] The training efforts have contributed to a workforce of building operators who are more aware of the implications of their decisions on the energy efficiency of their buildings.[55]

SERVICE PROVIDER INTEREST IN THE SECTOR

A subset of service providers remain interested in the office sector although several report that the economic downturn affected this sector most adversely. Some service providers focus exclusively on offices; some of those have an even narrower specialty, such as one service provider that reports focusing on mid-size office buildings (three to ten stories). Those service providers that do focus on the office sector understand how to work with the variety of stakeholders in the process, including property management firms, property owners, and tenants.

REMAINING TECHNICAL OPPORTUNITIES

Market actors report conflicting trends about the opportunities that remain in the office sector. Some market actors see continuing opportunities in the office sector. They identify task lighting, LEDs, HVAC, and boilers as primary opportunities from a measure category standpoint. They anticipate that the "green" competitive advantage will continue, though they recognize the challenges that this sector faces from a financial standpoint.

Some of the more prominent market actors indicate that the low-hanging fruit is gone. That is, the more sophisticated firms that saw the benefits of energy efficiency have already completed the projects that they saw were possible. The majority of the remaining potential will require deeper outreach among smaller property firms or will depend on larger property firms loosening their financial metrics for project approval.

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[52] Peters, Jane S., et al. 2009. "2008 BetterBricks Overall Market Progress Evaluation Report." Northwest Energy Efficiency Alliance.

[53] Navigant Consulting. 2010. *Long-Term Monitoring and Tracking: Report on 2009 Activities.* Prepared for NEEA.

[54] Navigant Consulting. 2010. *Long-Term Monitoring and Tracking: Report on 2009 Activities.* Prepared for NEEA.

[55] NEEA's 2011 Long-Term Monitoring and Tracking effort will include surveys of building operators to assess the extent to which the initiative has contributed to facility-level energy savings.

Additional opportunities may be created by a resolution adopted in 2010 by the City of Seattle that requires energy disclosure for non-residential buildings. Non-residential buildings over 50,000 square feet must benchmark and report their facilities' energy performance to potential buyers, lenders, lessees, and the City by April 2011; buildings over 10,000 square feet must start reporting by April 2012.[56] While the mandate may have a limited direct effect on PSE customers' electric usage, the utility does provide gas service to Seattle City Light's customers. In addition, a similar benchmarking requirement passed in New York City suggests that spillover effects of such mandates (e.g., improved access to and interest in energy benchmarking resources and tools) may drive additional energy savings in the region as a whole.[57]

REMAINING BARRIERS

Some of the barriers to achieving deeper penetration in the office sector are cyclical in nature, while others are structural. Several service providers singled out the commercial real estate sector as particularly hard hit by the economic recession. The key cyclical barrier is the limited access that this sector has to capital. As building values decreased, so did the owners' equity. The related weakening of balance sheets prevents building owners from securing financing at reasonable rates to support the implementation of energy efficiency projects. The projects that have been completed have had the shortest payback periods and highest ROIs. Investment in projects that meet the next tier of financial metrics will likely wait until after this sector's access to capital has expanded.

From a structural standpoint, the most visible barrier is the issue of split incentives. The vast majority of commercial leases are triple net leases, which require the tenant to pay the utility bills to the provider directly.[58] The tenant would realize the benefits of reducing its energy usage in these cases, but the tenant typically does not have the ability to make capital improvements at the facility. The facility owner or property management firm retains that right but would not realize any direct financial benefits from the project. The property owner could realize benefits from energy efficiency improvements if it could charge higher rents, but that is not always possible with an existing tenant.

Further, requirements to update certain equipment or entire facilities to code also hinder the completion of energy efficiency projects. Some upgrades trigger a requirement to upgrade specific equipment to code; sometimes it relates directly to the equipment being replaced, and sometimes it does not. In these cases, the capital required to upgrade auxiliary equipment is taken from the same "pool" of funds required to complete the energy efficiency retrofit, essentially decreasing the amount of capital available to complete the energy efficiency retrofit. In some cases, this results in a smaller-scale energy efficiency upgrade; in other cases, it may cause the project to fail the firm's financial metrics and result in project cancelation or delay.

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[56] City of Seattle Department of Planning and Development. 2011. "Our Program: Energy Benchmarking and Reporting." http://www.seattle.gov/dpd/GreenBuilding/OurProgram/PublicPolicyInitiatives/DPDP018682.asp

[57] Lowenberger, A., et al. 2010. "What Drives Energy Performance Scores: Benchmarking NYC High Rise Building Stock." 2010 ACEEE Summer Study on Energy Efficiency in Buildings.

[58] Jaffe, D. and R. Stanton and N. Wallace. November 30, 2010. *Energy Factors, Leasing Structure, and the Market Price for Office Buildings in the U.S.* Fischer Center for Real Estate and Urban Economics: University of California, Berkeley. Available: http://faculty.haas.berkeley.edu/ldavis/Enviro@Haas_files/JSW2010%5B1%5D.pdf

2.2.3.2 Public Sector

For the purposes of this report, the public sector analysis focused on state and local government office buildings. This concentration on a distinct set of building types and agency types enabled the evaluation team to probe deeper on the dynamics that affect these markets. Schools have received significant attention due to the availability of state funds to support projects. Wastewater treatment plants fit better into the category of industrial facilities than office facilities. The focus on office buildings also provided the opportunity to determine the extent to which state and local governments are subject to different forces than the private sector.

KEY CHARACTERISTICS OF PUBLIC SECTOR FACILITIES IN PSE SERVICE TERRITORY

The project team surveyed representatives of 49 public sector facilities in PSE service territory. For the Public Sector, Navigant examined two strata: State Government and Local Government. The project team sought to achieve 90/15 at the sector level (Public Sector) and 80/20 at the stratum level (State Government and Local Government). The sample included agencies' headquarters, branch locations, and single locations because decisions about energy efficiency projects are most often made at this level.

Figure 2.23 and Figure 2.24 include all of the facilities that were included in the population of potential survey respondents after the data cleaning was completed (black) as well as all of the facilities that responded to the survey (green) for the local government and state government segments, respectively. These two segments are shown on their own maps due to the large number of facilities in each population; the separate maps enabled a clearer representation of the respective populations.

As shown in Figure 2.25 through Figure 2.28, several characteristics of the public sector segment indicate that it is a promising market for energy efficiency:

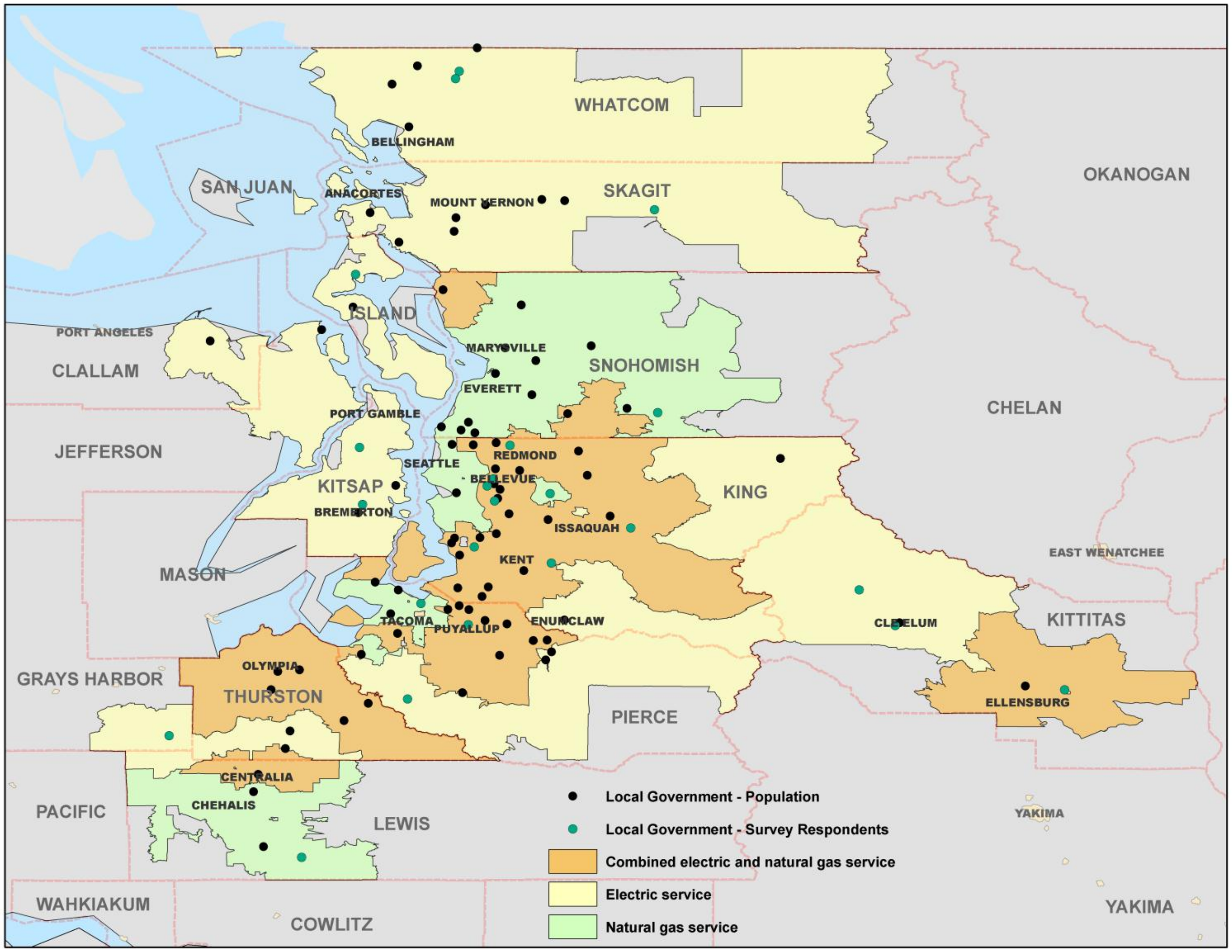
» The majority of the public sector facilities (92 percent) reported that they own and occupy their facilities, as shown in Figure 2.25.[59] These owner-occupied facilities ensure alignment between the financial goals of the party investing in energy efficiency and those of the party realizing the financial benefits.
» As shown in Figure 2.28, only 39 percent of public sector facilities indicate that they plan to invest capital in their facilities in the next two years; 53 percent of the facilities reported they don't have plans to invest. These results indicate that the opportunities to increase energy efficiency investments in the near term are somewhat limited in this sector.
» Public sector facilities vary in scale in terms of both facility size (Figure 2.27) and number of employees (Figure 2.26). Most of the facilities fall in the small and medium category in terms of facility size (10,001 – 100,000 sq. ft.). The majority of the facilities have a small to medium

[59] During the screening process for the surveys, 53 potential respondents in the State Government sector declined to continue the survey because they leased space in a building owned by a third party; no respondents in the Local Government sector indicated that this was an issue. When considering these records, only 44 percent of respondents to the survey or to the screening questions indicate that they own and occupy their own facilities. This is an area of stark contrast between local and state government facilities; 96 percent of local government facilities that responded to the survey or completed the screening questions reported owning and occupying their space while only 29 percent of state government facilities that responded to the survey or completed the screening question indicated that they own and occupy their space.

workforce size (between 1 and 500 employees). As in the case of the food processing sector, outreach efforts in the public sector likely need to include a larger number of facilities in order to achieve the same level of energy savings.

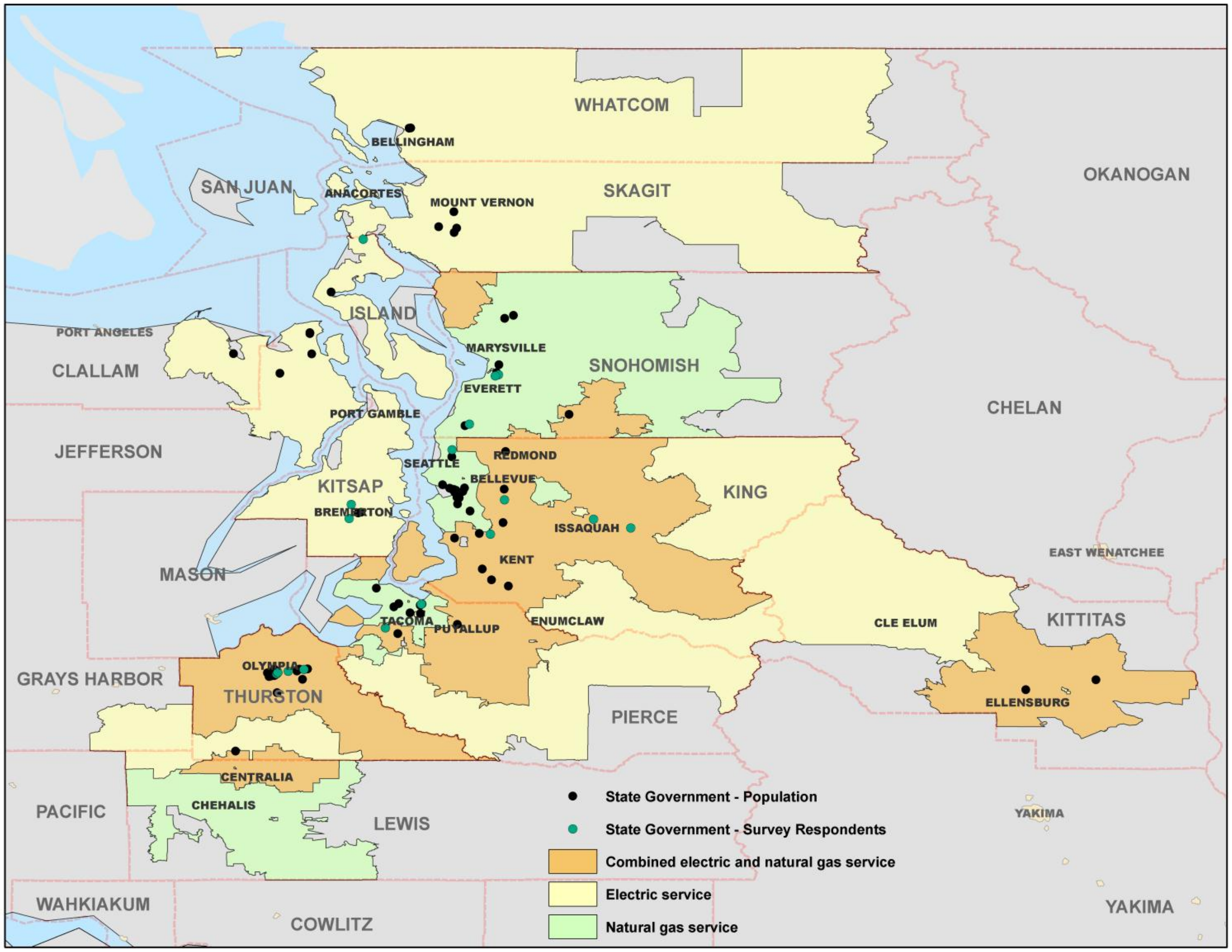
» As shown in Figure 2.29, the largest public sector facilities are located along the I-5 corridor and extend into Olympia. Facilities in the outlying areas tend to be smaller and are also more likely to be local government than state government facilities.

Figure 2.23. Local Government Sector Population and Survey Respondents



Source: Navigant analysis of E&W survey of PSE customers 2011.

Figure 2.24. State Government Sector Population and Survey Respondents



Source: Navigant analysis of E&W survey of PSE customers 2011.

Figure 2.25. Owner-Occupancy Rate – Public Sector (n=49)

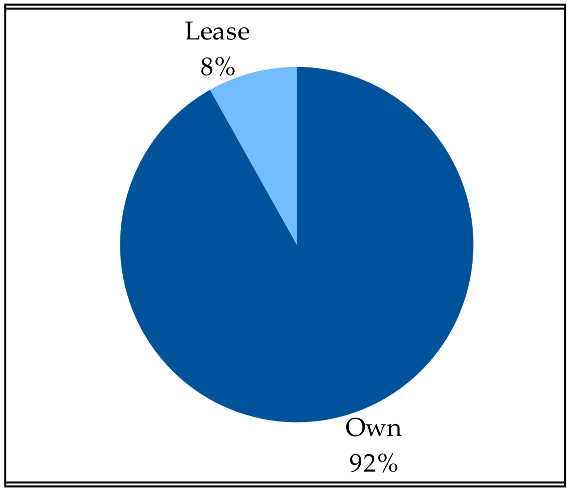


Figure 2.27. Facility Size – Public Sector (n=49)

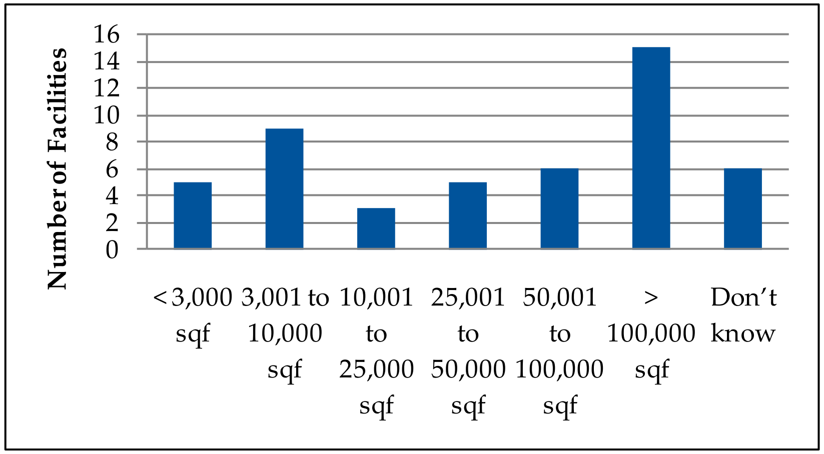


Figure 2.28. Planned Capital Spending in Next Two Years – Public Sector (n=49)

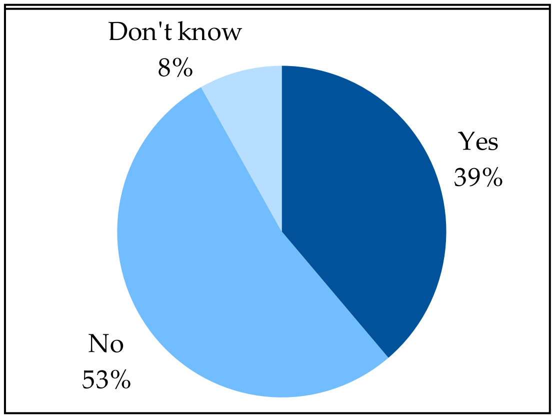
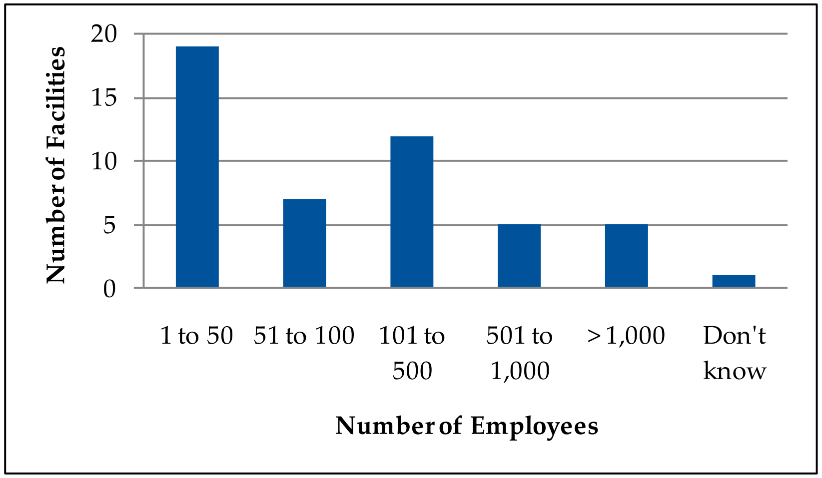
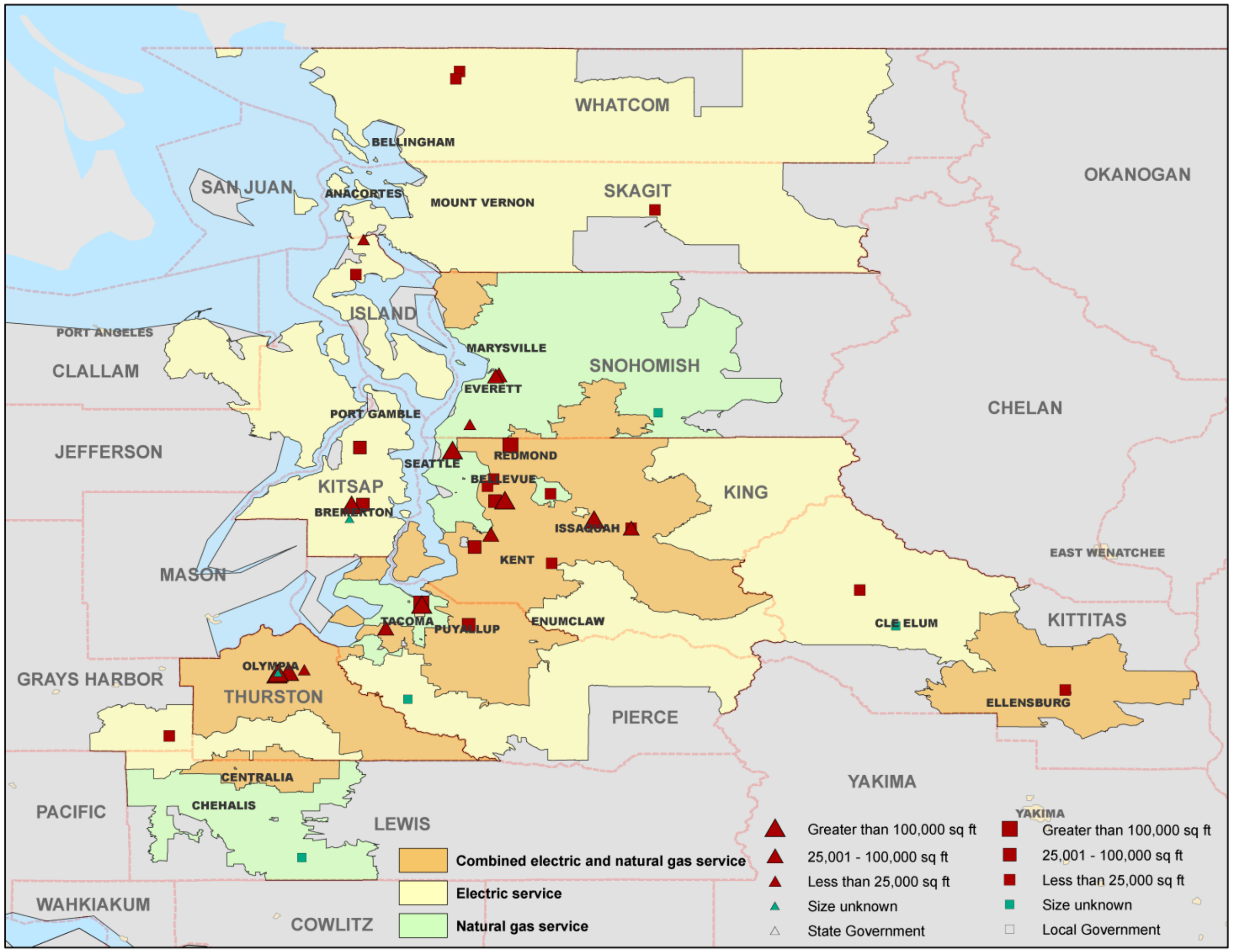


Figure 2.26. Number of Employees Per Facility – Public Sector (n=49)



Source for all figures on this page: Navigant and E&W Survey of Public Sector, 2011.

Figure 2.29. Public Sector Facility Size by Location



Source: Navigant analysis of E&W survey of PSE customers 2011.

Motivation to Pursue Energy Efficiency

Energy costs can account for up to 10 percent of a local government's annual operating budget. This creates potential for energy efficiency efforts to provide cost-cutting opportunities for cash-strapped municipalities.[60] Given the fiscal challenges faced by governments in the past few years, this cost reduction is a powerful driver.

As discussed in Section 2.2.2.1, the budget shortfalls have slowly created additional opportunities for energy efficiency through deferred maintenance decisions. Even prior to the economic downturn, government agencies opted to postpone regular maintenance on their facilities rather than cut staff or services.[61] It is such a significant issue in Washington State that local governments indicated that the implications of these decisions were the second-most important issue for future performance audits.[62] The result is a stock of equipment that is either running inefficiently or has failed, creating opportunities to make energy-efficient choices.

Further, the availability of federal funds to assist state and local governments with infrastructure improvement projects has added interest in this market since 2009. As discussed in Section 2.2.2.1, the EECBG funds have provided additional motivation and funding for energy efficiency projects at state and local government facilities. The ability to leverage these funds enabled many more projects than would have otherwise reached completion.

Sector Progress towards Energy Efficiency

Washington's Department of General Administration (GA) works with public facilities throughout the state to pursue energy efficiency upgrades, among other priorities. The GA's scope includes all public facilities, including schools, community colleges, and state and local government agencies.

The GA acts as a catalyst to initiate projects through its Energy Savings Performance Contracting (ESPC) Program. The ESPC provides assistance to publicly owned facilities in selecting and working with a pre-qualified ESCO to implement energy conservation measures without any capital outlay.[63] The GA releases a request for qualifications for ESCOs every other year and prepares a list of ESCOs that meet the agency's criteria. The GA sees this as an opportunity to create a list of trusted partners in deploying energy efficiency throughout the state. The GA does not work directly with BetterBricks, but it does use the information that BetterBricks provides.

In addition, the state adopted legislation in 2009 that establishes protocols for reviewing the energy performance of buildings in which Washington state agencies house operations.[64] Specifically, SB 5854 as adopted into law required state agencies to benchmark their facilities that are larger than

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[60] ACEEE. 2010. "Local Technical Assistance Toolkit: Lead by Example."

[61] Hood, J. 2011. "The States in Crisis." *National Affairs.* Available: http://www.nationalaffairs.com/publications/detail/the-states-in-crisis

[62] Washington State Auditor's Office. February 2011. *Local Government Performance Audit Survey Results.* Available: http://www.sao.wa.gov/EN/Audits/PerformanceAudit/Documents/Local_govt_outreach_results_PA_2011.pdf

[63] State of Washington: General Administration. June 2010. "Washington's Program." http://www.ga.wa.gov/eas/epc/municipal.htm

[64] The discussion about SB 5854 is based on the legislation: State of Washington 61st Legislature. 2009 Regular Session. "Climate Pollution Reduction – Energy Efficiency." Effective date July 26, 2009. Section 8. Available: http://apps.leg.wa.gov/documents/billdocs/2009-10/Pdf/Bills/Session%20Law%202009/5854-S2.SL.pdf

10,000 square feet by July 1, 2010; the GA would make those results public. Any facility with an ENERGY STAR rating less than 50 would receive a preliminary energy audit; the law requires more formal and detailed audits by July 1, 2013, if the initial audit identified cost-effective upgrade opportunities. The law requires that any cost-effective conservation measures identified in the more detailed audit be implemented by July 1, 2016. In addition, the law prohibits agencies from signing new leases with buildings that have ENERGY STAR ratings lower than 75 unless the property owner agrees to meet certain conditions.

One important caveat to the SB 5854 requirements is that they only apply to the extent that "specific appropriations are provided to those agencies" to support these specific requirements. These requirements are a step towards a greater commitment to energy efficiency, but the real commitment cannot be made until the funding is provided.

SERVICE PROVIDER INTEREST IN THE SECTOR

The public sector is one of the primary targets of the ESCO industry. Because of annual budgeting cycles and limits, local and state governments benefit greatly from the payment structure enabled by performance contracting. The market actors interviewed for this report agreed that the public sector uses performance contracting more than any other sector; local governments have used it more in the past than state governments. In part, this may be due to the fact that the GA makes energy efficiency investment decisions for many state agencies. The GA's Resource Conservation Manager can provide the expertise on technologies, related financial commitments, and investment structures. Few local governments have access to these types of resources, making ESCOs an attractive alternative.

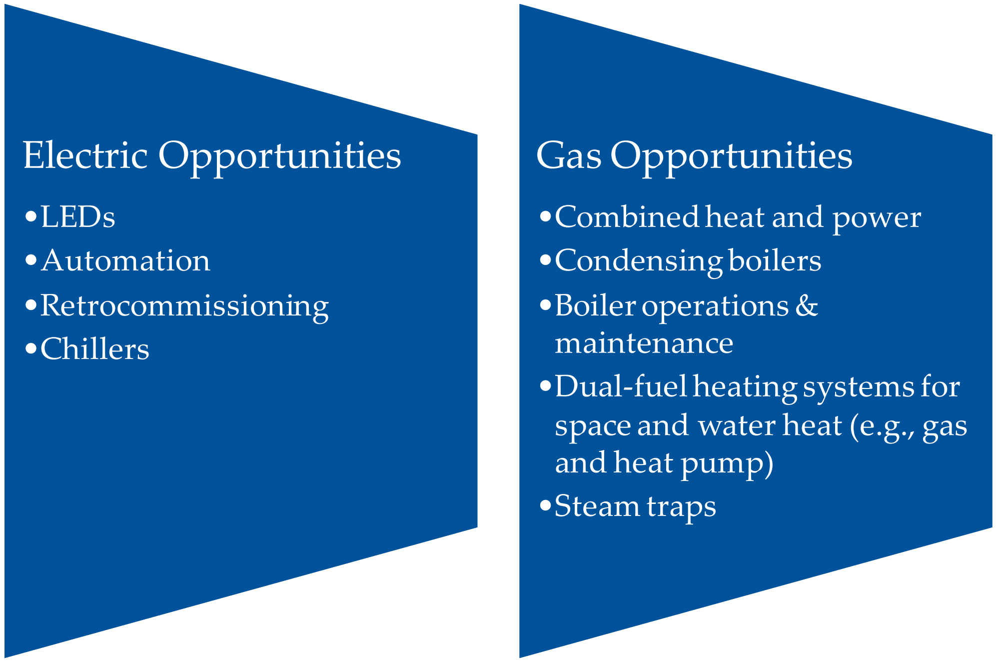
One service provider indicated that the best opportunities for the public sector are found among municipalities with populations ranging from 50,000 to 70,000 people. This service provider indicated that many of these municipalities have established redevelopment objectives in addition to greenhouse gas reduction targets. Together, these mandates create a solid platform for initiating energy efficiency projects.

REMAINING TECHNICAL OPPORTUNITIES

Service providers recognize a wide variety of remaining opportunities for public sector office buildings. Like the rest of the market, automation provides significant opportunity for future energy efficiency projects. Such automation has added benefits for government agencies, which often pay separate utility bills for multiple facilities. The GA believes that automation could enable centralized utility billing, which would reduce the cost of administering those accounts; further, it would provide additional insight into which facilities have sub-par energy performance.

As identified in Figure 2.30, service providers identified several other energy efficiency project opportunities for public sector buildings. At this point, none of the remaining opportunities stood out as game-changers. The completed surveys with end users should reveal additional project opportunities.

Figure 2.30. Additional Project Opportunities for Public Sector Office Buildings



Source: Navigant analysis of market actor interviews 2011.

REMAINING BARRIERS

The primary barrier to energy efficiency investments in state facilities is access to capital. State projects rely on the state's capital budget for funding. During the 2009-11 budget cycle, Washington diverted funds from the capital budget to the operating budget.[65] As a result, state facilities did not have access to the capital needed to undertake most energy efficiency projects.

Market actor interviews support the findings of other utility and state agency programs regarding barriers to energy efficiency at the local government level. These barriers include the following:

» Lack of staff resources and in-house energy expertise

» Lack of information and familiarity with energy efficiency technologies and performance contracting mechanisms

» High first costs and unavailability of financing for energy projects[66]

PSE staff has previously confirmed these barriers for the PNW market. In a 2009 paper, PSE staff state that tight municipal budgets and staff resources rarely allow for replacing energy-using equipment until failures occurs; even then, these limitations may affect the selection of higher efficiency replacements.[67]

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[65] Warnick, Judy. May 3, 2011. "Washington state House should approve the Debt Reduction Act." The Seattle Times. (http://seattletimes.nwsource.com/html/opinion/2014949416_guest04warnick.html?syndication=rss).

[66] Chamberlain, B., et al. 2008. "Leading by Example: Streamlining EE in the Local Government Sector." 2008 ACEEE Summer Study on Energy Efficiency in Buildings.

[67] Feinstein, L. and B. Rupert. 2009. "Prioritizing Energy Efficiency in Municipalities." 2009 ACEEE Summer Study on Energy Efficiency in Industry.

2.2.3.3 Hospitals

Energy efficiency provides an important opportunity for hospitals to reduce costs and increase profits while improving the patient experience. Hospitals are under continuing pressure to increase profits at the same time that payments to hospitals from insurance companies are decreasing. Yet, convincing decision makers to invest in energy efficiency when their business is driven by the capability to provide treatment is difficult. NEEA's work with this sector has provided a strong lead for future involvement by PSE.

KEY CHARACTERISTICS OF HOSPITAL FACILITIES IN PSE SERVICE TERRITORY

Navigant interviewed representatives of 18 hospitals in PSE service territory. The hospitals were selected based on membership in the Washington State Hospital Association (WSHA) in conjunction with their appearance in either of the lists of PSE's Top 1,600 customers for gas or electric service. This approach targeted the largest hospitals in the PSE service territory. Figure 2.31 includes all of the facilities that were included in the population of potential survey respondents after the data cleaning was completed (black) as well as all of the facilities that responded to the survey (green).

As shown in Figure 2.32 through Figure 2.35, several characteristics of the hospitals in market segment indicate that it is a promising market for energy efficiency:

- All of the respondents reported that they own and occupy their facilities, as shown in Figure 2.33. This eliminates the challenge of split incentives and ensures alignment between the party investing in energy efficiency and the party realizing the financial benefits.
- As shown in Figure 2.35, the vast majority of hospitals (89 percent) indicate that they plan to invest capital in their facilities in the next two years. The willingness to commit capital resources to their facilities during the time of economic uncertainty creates opportunities for energy efficiency investment during the near term.
- Hospital facilities are of considerable scale in terms of both facility size (Figure 2.32) and number of employees (Figure 2.34). With more than half of facilities falling in the largest category of both facility size (100,000 sq. ft.) and number of employees (greater than 1,000), outreach to a few facilities should lead to a larger number of energy efficiency project opportunities.
- The largest hospitals in PSE's service territory tend to be located along the I-5 corridor south of Seattle, as shown in Figure 2.36. Mid-size facilities tend to be located in the counties surrounding King County. Very few facilities represented in the survey were located more than 50 miles from Seattle.

Figure 2.31. Hospital Sector Population and Survey Respondents

Source: Navigant analysis of E&W survey of PSE customers 2011.

Figure 2.33. Owner-Occupancy Rate – Hospitals (n=18)

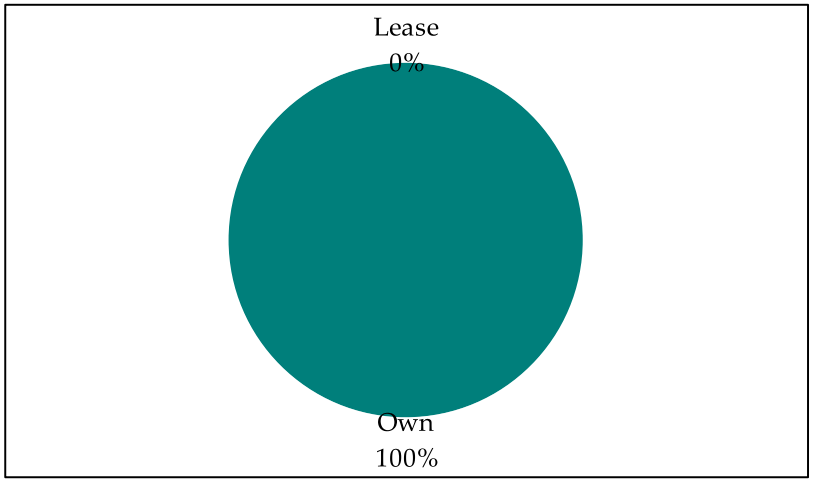


Figure 2.32. Facility Size – Hospitals (n=18)

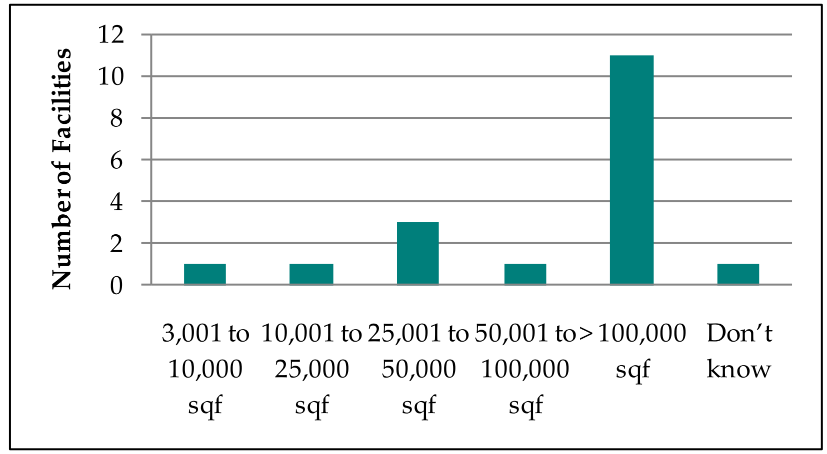


Figure 2.35. Planned Capital Spending in Next Two Years – Hospitals (n=18)

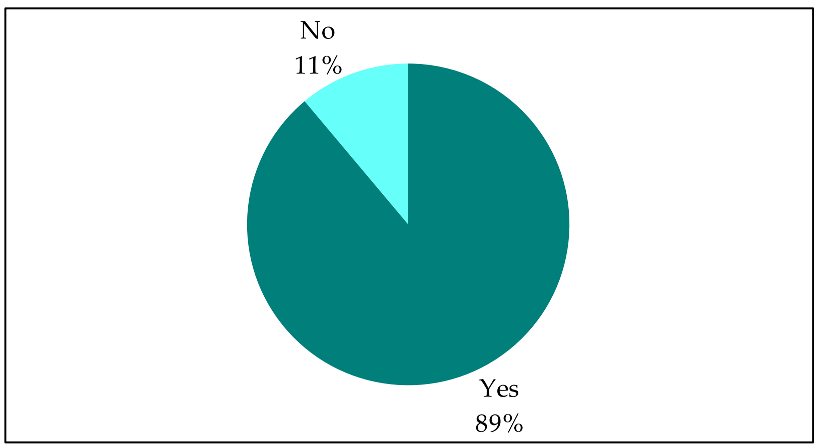
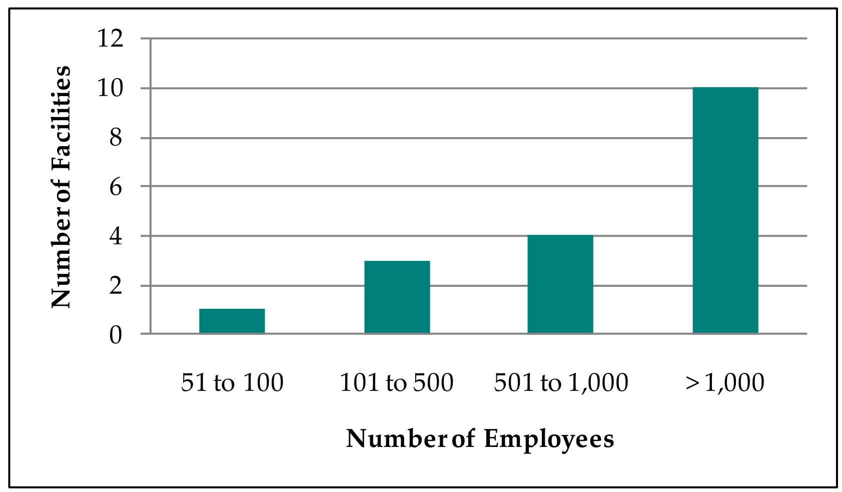


Figure 2.34. Number of Employees Per Facility – Hospitals (n=18)



Source for all figures on this page: Navigant and E&W Survey of Hospitals, 2011.

Figure 2.36. Hospital Sector Facility Size by Location

Source: Navigant analysis of E&W survey of PSE customers 2011.

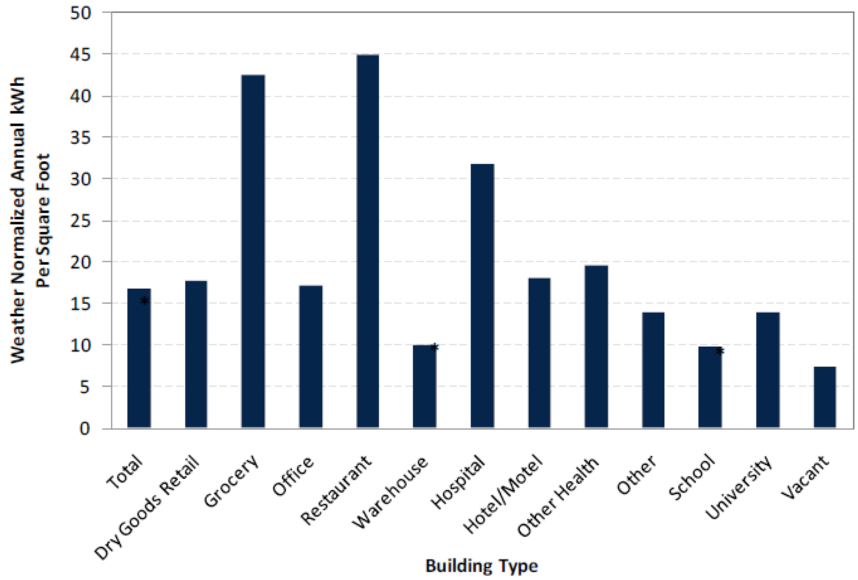
MOTIVATION TO PURSUE ENERGY EFFICIENCY

Hospitals and health care facilities present another attractive target sector for PSE's energy efficiency efforts. A combination of market characteristics, energy use patterns, and previous work in energy efficiency indicate that the hospital sector is ready to engage with utilities on energy efficiency:

- **Concentration of ownership:** Concentration of ownership among hospitals in Washington State indicates potential for economies of scale in program implementation, similar to the office sector. More than half (52 percent) of the hospital beds in Washington are in one of 38 hospitals which are part of 18 individual hospital systems.[68]
- **High energy use intensity:** Hospitals have energy use intensities that are approximately twice as high as commercial office buildings in the PNW[69], as shown in Figure 2.37.
- **High level of awareness:** Hospitals representing approximately one-third of the beds in the PNW have a high level of awareness regarding specific energy efficiency opportunities within their facilities.[70] These facilities adopted Energy Management Plans (SEMPs) as a result of NEEA's focus on this sector.
- **Motivation to increase profits.** Hospitals are willing to invest in cost-reducing energy efficiency measures to improve profits. Reducing energy costs can help hospitals to offset threats to profitability caused by insurance costs, reimbursements, and increased competition.[71]

[68] Peters, Jane S., et al. 2009. "2008 BetterBricks Overall Market Progress Evaluation Report." Northwest Energy Efficiency Alliance.
[69] Cadmus Group. December 2009. "Northwest Commercial Building Stock Assessment." Northwest Energy Efficiency Alliance.
[70] Peters, Jane S., et al. 2009. "2008 BetterBricks Overall Market Progress Evaluation Report." Northwest Energy Efficiency Alliance.
[71] Peters, Jane S., et al. 2009. "2008 BetterBricks Overall Market Progress Evaluation Report." Northwest Energy Efficiency Alliance.

Figure 2.37 Annual Electric Energy Use Intensity by Building Type



Source: Cadmus Group 2009.

SECTOR PROGRESS TOWARDS ENERGY EFFICIENCY

Through its partnerships with healthcare industry organizations, NEEA's BetterBricks initiative has laid the foundation for energy efficiency in the hospital sector in the Northwest. NEEA worked to solidify key market actor partnerships with the Washington State Society for Healthcare Engineering (WSSHE), the national chapter of the American Society of Healthcare Engineers (ASHE), and ENERGY STAR. With ASHE and the U.S. Environmental Protection Agency (EPA), NEEA helped drive the development of the Energy Efficiency Commitment (E2C) Campaign. E2C seeks to generate energy efficiency savings through both operational changes and capital investments[72] with participating health care facilities, including 18 hospitals in PSE's service territory.[73]

These partnerships have helped NEEA secure widespread adoption of strategic energy management plans. The plans include the key to achieving energy savings at each facility. SEMPs include best practices for guiding financing decisions, capital updates, and monitoring and tracking. Early-stage efforts focused on identifying efficiency opportunities, calculating project paybacks, and creating actions plans to address such projects over time. In the 2008 evaluation, all surveyed hospital contacts indicated that developing such plans was not something that they could have done without assistance from BetterBricks.[74]

In addition, NEEA and others have collaborated to develop information and tools to support hospitals in their efforts to learn about and invest in energy efficiency. For example, the *Guide to Optimizing Hospital*

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[72] BetterBricks. May 17, 2010. "Energy-Intensive Healthcare Facilities Work Together to Reduce Energy Use by 10 Percent." Press release. Available: http://www.betterbricks.com/news-room/energy-intensive-healthcare-facilities-work-together-reduce-energy-use-10-percent

[73] PSE. 2010. "Energy Efficiency Services 2010 Annual Report of Energy Conservation Accomplishments."

[74] McRae, M., et al. Research Into Action, Inc. 2008. "Market Progress Evaluation Report #3; BetterBricks Hospital and Healthcare Initiative." Northwest Energy Efficiency Alliance.

Facility Investments provides the basic information necessary to compare infrastructure investments (including life cycle cost analysis) and information about financing options to support those investments.[75] Step-by-step guides to developing strategic energy management plans support the development of these important plans.[76]

SERVICE PROVIDER INTEREST IN THE SECTOR

Service providers have recognized the sector's interest in energy efficiency and are serving this sector. ESCOs, consultants, and contractors indicate that hospitals are a strong market for energy efficiency. Several firms that participated in interviews for this project indicated that hospitals were a specific sector focus for their organization.

REMAINING TECHNICAL OPPORTUNITIES

Research indicates that a variety of technical opportunities exist in the hospitals sector:

» According to research co-sponsored by the University of Washington's Integrated Design Lab, approximately 50 percent of that energy provides water and space heating. This results in high potential for no- and low-cost energy efficiency improvements, including 10-20 percent savings from tune-ups and improved operations alone.[77] On a related note, service providers indicate that heat recovery systems present a good opportunity for the hospital sector.

» As in the other sectors, building automation could be expanded in the hospitals sector.

» Reducing the energy intensity of lighting is also an area of opportunity. Hospitals have expressed specific interest in LEDs, and service providers see additional potential for daylighting. Given the implications for patient health[78], daylighting may achieve multiple goals for hospitals.

» Service providers also indicate that additional opportunities exist for high-efficiency motors and VSDs in addition to refrigeration (e.g., for blood components).

As shown in Table 2-10, around half of respondents to the hospital survey indicate that food service equipment, laundry equipment, operating room equipment, dryers and new lab equipment, and surgical lighting are applications where some progress has already been done to achieve greater energy efficiency savings These same respondents identified technology applications specific to the hospital setting that pose additional opportunity for energy efficiency savings. These applications include food service equipment, operating room equipment, and boiler/HVAC systems.

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[75] ECONorthwest. Undated. *Guide to Optimizing Hospital Facility Investments.* Northwest Energy Efficiency Alliance. Available: http://www.betterbricks.com/graphics/assets/documents/FinanceGuideFinal.pdf

[76] BetterBricks. Undated. "SEMP Tools & Resources." Northwest Energy Efficiency Alliance. Available: http://www.betterbricks.com/healthcare/tools/semp-tools-resources

[77] Loveland, J., et al. 2006. "Target 100: Re-Envisioning Today's Hospital Prototype for Greatly Improved Energy Efficiency, Human Well-Being and Performance." 2010 ACEEE Summer Study on Energy Efficiency in Buildings.

[78] See, for example, Lee, J. and K. Song. 2007. "The Daylighting Effects in Hospital for Healing Patients." Rotterdam (Netherlands) in-house publishing, p. 869-874. Fraunhofer, IRB. Available: http://www.irbdirekt.de/daten/iconda/CIB8201.pdf

Table 2-10. Hospital-Specific Equipment: Progress and Remaining Opportunities

Technology	Replaced Already?	Opportunities Remain?
Food Service Equipment	17%	22%
Laundry Equipment	6%	0%
Exam/Diagnostic & Laboratory Equipment	0%	0%
Operating Room Equipment	11%	11%
Office Equipment	0%	0%
Dryers, New Lab Equipment	6%	0%
Surgical Lighting	6%	0%
Boiler / HVAC System	0%	6%
# of respondents to the survey in this sector	**18**	**18**
Number of responses provided	8	7
# of respondents to the question	8	9
Source: Navigant and E&W survey with Hospital sector 2011.		

REMAINING BARRIERS

Despite these favorable trends, hospitals often lack the capital necessary to complete the projects that will lower energy costs. In other regions, a survey by the Ontario Hospital Association indicated that 55 percent of hospitals cited a lack of internal funding for efficiency as a reason that they did not implement more energy efficiency measures; in a separate question, 45 percent cited a lack of incentive funding as a primary barriers.[79] Service providers in PSE's service territory indicate that performance contracting is common in this sector, though not as widespread as in the public sector.

As with many other sectors, the efficiency of the building is not part of hospitals' core competencies. Hospitals have historically focused on capital investment in medical devices before investing in their buildings; hospital executives have viewed the medical devices as competitive advantages to growing top-line revenue. Accordingly, staff expertise has focused on those medical devices; few staff have deep expertise in the energy aspects of the facility or equipment.

2.2.3.4 Food Processing

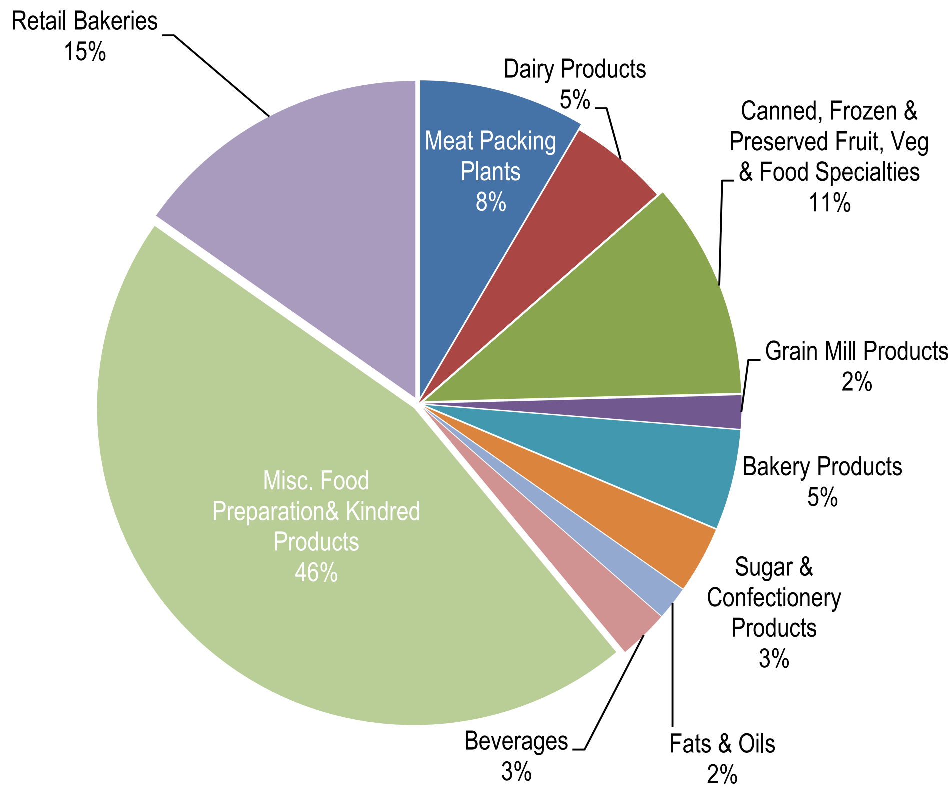
The Northwest food manufacturing sector comprises a wide range of sub-segments and company sizes. According to NEEA's latest Industrial Initiative Market Progress Evaluation Report, the PNW region includes approximately 440 individual food processing companies with 524 individual facilities. More than one-quarter of those facilities are members of the Northwest Food Processors Association (NWFPA).[80]

[79] Jefferson, J. 2006. "Energy Efficiency Opportunities in Ontario Hospitals." Ontario Hospital Association.
[80] The Cadmus Group. 2011. "NEEA Market Progress Evaluation Report #6: Evaluation of NEEA's Industrial Initiative." Northwest Energy Efficiency Alliance.

KEY CHARACTERISTICS OF FOOD PROCESSING FACILITIES IN PSE SERVICE TERRITORY

The food processing sector in PSE's service territory represents a diverse mix of specialties, workforce size, and sales volume. Figure 2.38 shows the distribution of the food processing sector by industry title. The food processing sector in PSE's territory used for the sampling includes a total of 118 facilities ranging from dairy products to miscellaneous food preparations and kindred products. These facilities have annual sales of at least $10 million or have at least 20 employees.

Figure 2.38. Distribution of Food Processing Sample by Industry Title



Source: Navigant analysis of InfoGroup list 2011.

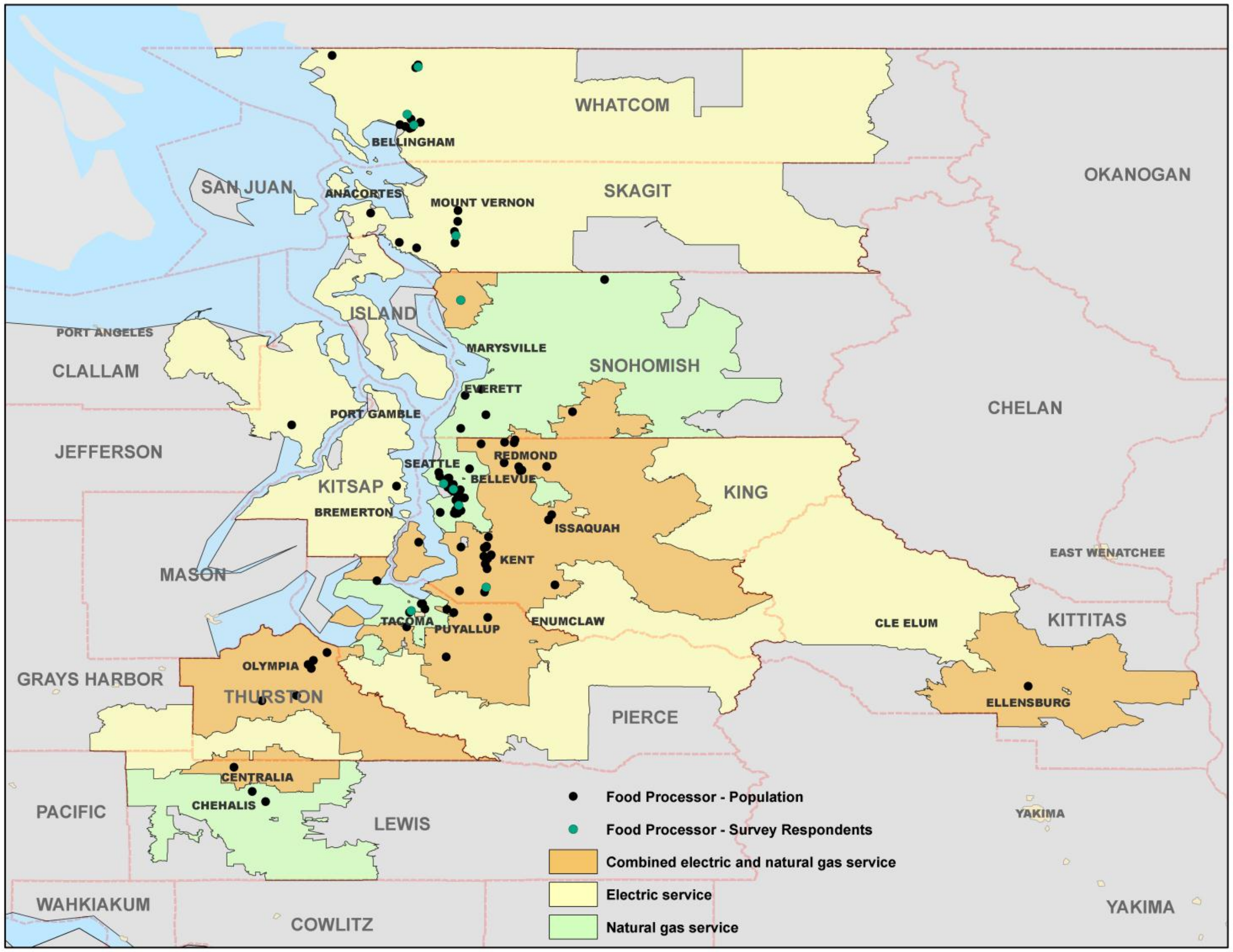
The project team surveyed representatives of 11 food processing facilities in PSE service territory. A list of facilities with an NAICS code that begins with 311 served as the starting point for selecting facilities for the sample frame. Facilities with fewer than 20 employees or less than $10 million in revenue were excluded from the sample frame. The remaining list of facilities represented facilities with enough resources, either staff or financial, to make a significant commitment to energy efficiency.

Figure 2.39 includes all of the facilities that were included in the population of potential survey respondents after the data cleaning was completed (black) as well as all of the facilities that responded to the survey (green).

As shown in Figure 2.40 through Figure 2.43, several characteristics of the food processing market segment indicate that it is a promising market for energy efficiency:

- The majority of the food processing facilities (73 percent) reported that they own and occupy their facilities, as shown in Figure 2.41. These owner-occupied facilities have alignment between the financial goals of the party investing in energy efficiency and those of the party realizing the financial benefits.
- As shown in Figure 2.43, a significant number of food processing facilities (73 percent) indicate that they plan to invest capital in their facilities in the next two years; nine percent of the facilities reported that they are unsure of their investment plans. Most facilities are willing to commit capital resources to expand their business in the near term, which creates opportunities for energy efficiency investment.
- Food processing facilities vary in scale in terms of both facility size (Figure 2.40) and number of employees (Figure 2.42). Most of the facilities fall in the small and medium category in terms of facility size (10,001 – 100,000 sq. ft.). The majority of the facilities have a small number of employees (between 1 and 50 employees). Outreach efforts in this sector likely need to include a larger number of facilities than the hospital sector, for example, in order to achieve the same level of energy savings.
- Unlike the other focus sectors, the food processing sector's largest facilities are geographically distributed throughout the PSE service territory, as shown in Figure 2.44. Although the only facility larger than 100,000 square feet is located in Seattle, half of the remaining facilities larger than 25,000 square feet are located north of King County. This reflects the food processing sector's connection to the fishery industry, some of which is tied to the northern regions of PSE's service territory.

Figure 2.39. Food Processor Sector Population and Survey Respondents



Source: Navigant analysis of E&W survey of PSE customers 2011.

Figure 2.41. Owner-Occupancy Rate – Food Processing (n=11)

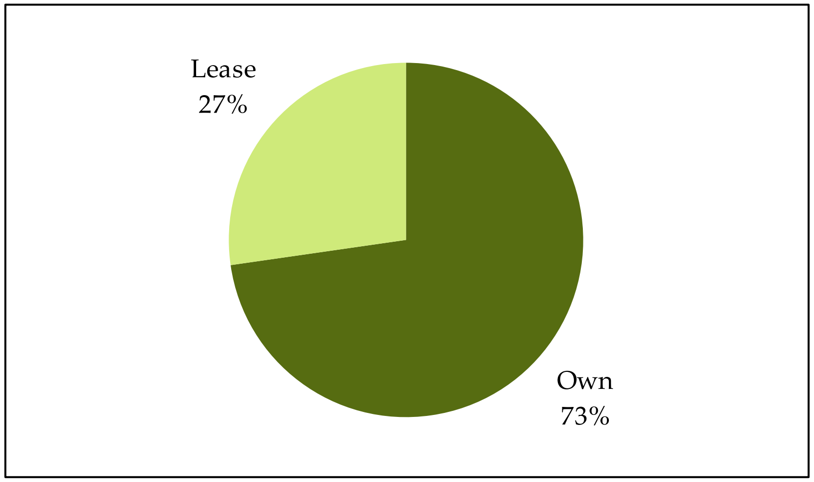


Figure 2.40. Facility Size – Food Processing (n=11)

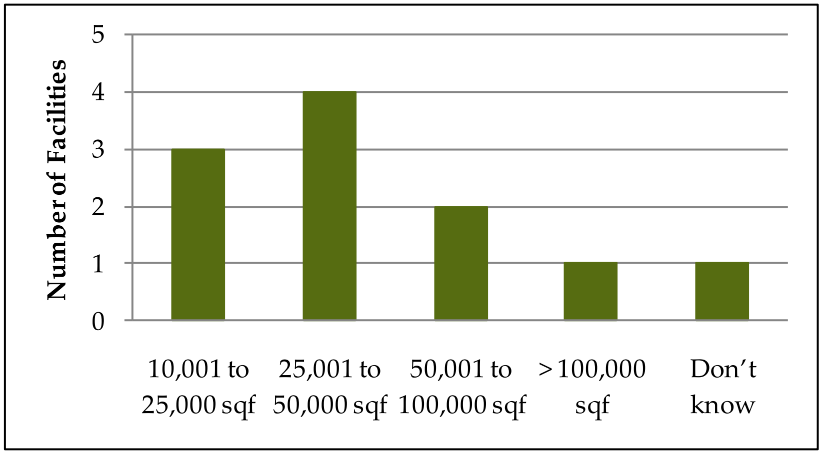


Figure 2.43. Planned Capital Spending in Next Two Years – Food Processing (n=11)

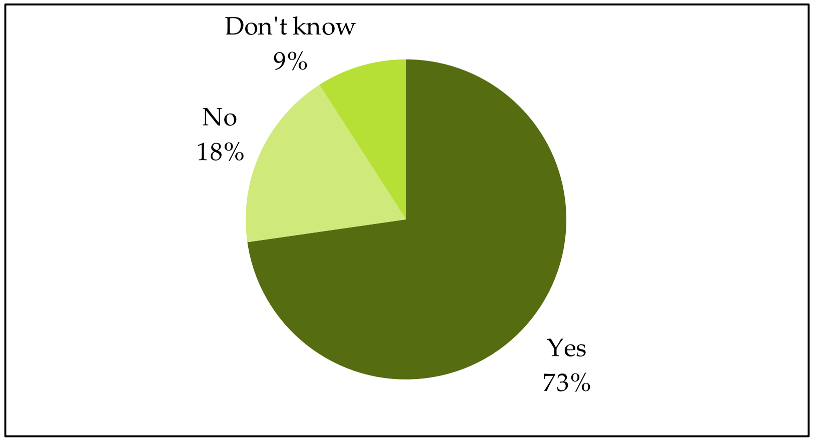


Figure 2.42. Number of Employees Per Facility – Food Processing (n=11)

Source for all figures on this page: Navigant and E&W Survey of Food Processors, 2011.

Figure 2.44. Food Processing Sector Facility Size by Location

Source: Navigant analysis of E&W survey of PSE customers 2011.

MOTIVATION TO PURSUE ENERGY EFFICIENCY

The food processing sector in the Northwest is motivated to decrease its energy usage. Members of the NWFPA established a goal to reduce energy intensity by 25 percent in 10 years and by 50 percent in 20 years. [81] In part, this goal reflects increasing levels of competition in the industry, especially related to price. As the industry anticipates increasing costs of key inputs, the increase in competition results in a focus on cost reductions.[82] NWFPA has worked with its members to identify energy as a controllable input to production, which has increased members' focus on energy-saving opportunities.

SECTOR PROGRESS TOWARDS ENERGY EFFICIENCY

To achieve its goal, the food processing industry has already taken steps to reduce energy usage. In large part, NWFPA has led these efforts through its partnership with NEEA, which PSE has leveraged in the past. [83] NWFPA's Director of Energy works closely with NEEA to increase members' participation in the Continuous Energy Improvement (CEI) program. The CEI program focuses on encouraging manufacturers' adoption of Strategic Energy Management efforts. As of 2009, NEEA had secured such CEI efforts from 36 percent of the overall PNW industrial and manufacturing sector. The food processing industry represents the largest share of these CEI activities, accounting for nearly 72 percent of electric savings and 100 percent of gas savings from the program.[84]

NWFPA's partnership with NEEA has led to **three pilot projects in the Northwest.[85]** These projects have optimized operational procedures for different types of industrial equipments and processes such as boilers and steam systems, refrigeration controls, and heat recovery equipment. The projects achieved annual savings from energy efficiency ranging from $9,000 to $150,000. This focus on energy savings has resulted in improved productivity and enhanced product quality as well as enhancements to inter-facility and corporate communication. Although none of these projects took place in PSE's territory, NWFPA's efforts to raise industry awareness about the results and the related opportunities make these efforts relevant to PSE.

Independent of NEEA, NWFPA's energy efforts focus on **raising awareness and providing tools** to its members to achieve their energy intensity reduction targets. NWFPA is developing two roadmaps to guide efforts to achieve the energy intensity reduction goals: a roadmap to guide efforts at the facility level and an industry-level roadmap to direct industry- and association-level efforts.[86] To facilitate efforts at the facility level, NWFPA hosts periodic workshops for its membership to increase awareness and familiarity with energy efficiency opportunities. NWFPA membership recently established an Energy Committee, comprised entirely of members, to provide input on NWFPA's programmatic efforts and policy priorities.

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[81] Barrow, P. June 2, 2010. "Energy Roadmap Projects Put NWFPA Membership on the Road." Northwest Food Processors Association. http://www.nwfpa.org/nwfpa.info/component/content/article/37-boiler/55--energy-roadma

[82] The Cadmus Group. 2011. "NEEA Market Progress Evaluation Report #6: Evaluation of NEEA's Industrial Initiative." Northwest Energy Efficiency Alliance.

[83] PSE. 2010. "Energy Efficiency Services 2010 Annual Report of Energy Conservation Accomplishments."

[84] The Cadmus Group. 2011. "NEEA Market Progress Evaluation Report #6: Evaluation of NEEA's Industrial Initiative." Northwest Energy Efficiency Alliance.

[85] Peterson, S. and P. Barrow. 2010. "Maximizing Energy Efficiency: Collaborative Goal Setting for Energy Intensity Reduction." Prepared for Behavior, Energy, and Climate Change Conference 2010.

[86] Northwest Food Processors Association. 2011. "Energy." Available: http://www.nwfpa.org/advocacy/energy

The EPA's **ENERGY STAR Program** serves as a complement to these regional efforts. EPA published the 2008 *ENERGY STAR Guide for Energy and Plant Managers* that specifically targeted the fruit and vegetable processing industry. The guide provides an extensive characterization of the associated energy-using processes in such facilities, and includes a diverse list of potential energy conservation measures.[87]

SERVICE PROVIDER INTEREST IN THE SECTOR

Service providers have begun to focus on this sector in response to the food processing sector's attention to energy efficiency. Several firms indicated in interviews that food processors are already part of their customer list. One of the major ESCOs interviewed for this project indicated that it had just conducted an analysis of the food processing sector, indicating that it is at least being considered as a new market. NWFPA has encouraged these efforts by enabling service providers to join the association as Supplier Members, giving them access to NWFPA member events and contact information.

REMAINING TECHNICAL OPPORTUNITIES

Solid opportunities remain to achieve energy efficiency in the food processing sector.[88] The food processing sector is unique because its energy use is dominated by natural gas, which accounts for an average of 60-70 percent of a facility's energy consumption.[89] Boilers are the primary consumer of natural gas and represent a significant opportunity for future energy efficiency, either through tune-up/maintenance programs or through efficient replacements. On the electricity side, NWFPA recognizes refrigeration as the primary opportunity with compressed air and HVAC as other areas with potential.

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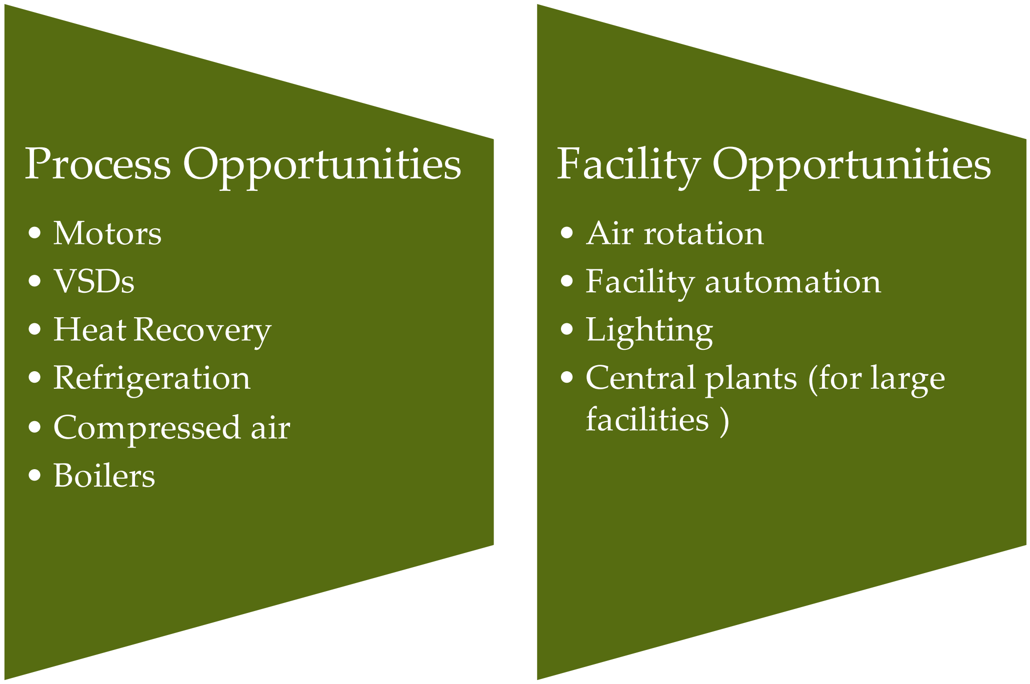
[87] Masanet, M., et al. 2008. "Energy Efficiency Improvement and Cost Saving Opportunities for the Fruit and Vegetable Processing Industry." Ernest Orlando Lawrence Berkeley National Laboratory.

[88] An additional example of "deep efficiency" food preparation facilities is Sierra Nevada Brewing Company's facilities in California. Additional information about those efforts can be found in the following reference: Chastain, C. Undated. "Brewing a Successful Sustainability Program."

[89] Interviews with NWFPA, NEEA. 2011.

Figure 2.45. Remaining Technology Opportunities in the Food Processing Sector



Source: Interviews with market actors 2011.

PSE's 2007 DSM potential study further disaggregates the food manufacturing sector's energy consumption by equipment category, with most potential electricity and gas savings attributable to various types of process equipment (e.g., cooling, motors, boilers, and heating).

Table 2-11 shows that around 30 percent of respondents to the food processors survey indicate that food process refrigeration/freezing, drying/cooking/baking, mixing and emulsification, materials handling/conveyor motors, compressed air and hydraulic systems, and liquid nitrogen and spiral freezer are some technologies where progress has already been done to achieve energy efficiency savings. Most of the respondents to the survey (81 percent) report that a number of opportunities remain in the following sector-specific technologies: heat processing, cold storage, process refrigeration/freezing, materials handling/conveyor motors and water generation.

Table 2-11. Food Processing Equipment: Progress to Date and Remaining Opportunities

Technology	Replaced Already?	Opportunities Remain?
Heat Processing	0%	9%
Dehydration	0%	0%
Filtration	0%	0%
Separation and Distillation	0%	0%
Drying/Curing/Baking	9%	0%
Cold Storage	0%	9%
Process Refrigeration/Freezing	9%	27%
Mixing and Emulsification	9%	0%
Materials Handling/ conveyor Motors	18%	18%
Compressed Air & Hydraulic systems	9%	0%
Steam system	0%	0%
Liquid nitrogen, spiral freezer	9%	0%
Water Generator	0%	9%
Number of responses provided	7	8
# of respondents to the question	3	9
# of respondents to the survey in this sector	11	11

Source: Navigant and E&W survey with Food Processors 2011.

REMAINING BARRIERS

Barriers remain to achieving the remaining energy efficiency potential in the food processing sector despite all of the trends in favor of deeper penetration in this sector. Food processors note a lack of familiarity with high efficiency technologies and insufficient staff time as barriers to considering such projects[90], which is consistent with barriers to adoption of energy efficiency across the C&I sectors, as discussed in Section 2.2.2.1. Service providers in the Northwest also indicate that the availability of capital also prevents full realization of energy efficiency potential in the food processing sector.

The seasonal nature of food processing operations creates unique challenges to completing projects, according to service providers. Most significantly, market actors must capture the attention of decision makers during the down season because the decision makers are too focused on operations during the busy season. If a market actor is able to attract the attention of a decision maker during the offseason, the project cannot usually be completed until the next down season at the earliest. The cost of interrupting operations during the busy season typically overwhelms any positive cash flow generated by an energy efficiency project. By the time that the next down season arrives, other concerns may have arisen, and the

[90] Shoemaker, S. 2006. "Technology Roadmap: Energy Efficiency in California's Food Industry." California Energy Commission; Public Interest Energy Research Program.

decision makers may determine that the energy efficiency project is no longer of primary importance. In the best cases, a project is delayed; in other cases, the project may be canceled. This long sales cycle and high level of uncertainty deter some service providers from investing the time needed to sell these projects.

2.2.3.5 Schedule 257 Customers

PSE's LED Traffic Signal program is a rebate program that is designed to increase replacement of existing traffic signals with energy-efficient LED traffic lights. The program educates public-sector customers on the benefits of installing red, yellow, and green LED traffic signals. PSE provides an LED informational packet along with a rebate application by mail or in person. Customers must receive electric service from PSE to qualify for the rebates, and customers with unmetered accounts must document all connected load at the intersection. New installations are not eligible for an incentive as the LED traffic lights are required by code. The LED Traffic Signals program is funded by Schedule 257.

As part of the Market Evaluation, Navigant interviewed representatives of one local government and the Washington State Department of Transportation. Navigant discussed the factors in decisions to replace traffic lights, progress towards replacing traffic lights, and the remaining opportunities in this area with the director of the department in charge of managing traffic light projects at each organization. Navigant asked the respondents to speak about their experience as well as the trends that they have seen among similar organizations regarding replacement of traffic signals with LEDs.

Findings from the interviews indicate that transportation agencies have already replaced all the old traffic light signals that could be replaced. There are a small percentage of old traffic lights that cannot be replaced because of technological barriers; depending on the type of signal head, some systems need incandescent lights in order to program them correctly. Respondents estimated that only about 2 percent of old traffic lights are not replaced with LEDs because of this technology constraint.

The respondents indicate that the role of a utility incentive is minor or ancillary to the decision to replace traffic lights. Replacements make economic sense without the utility incentive due to cost savings in three areas: energy, operating, and maintenance cost savings. In one case, old traffic lights started being replaced before the agency knew about related utility incentives.

PSE may consider sunsetting the Schedule 257 offerings due to market saturation and free-ridership issues. Interview findings indicate this market may be transformed. Municipalities are choosing to implement old traffic lights with LEDs in the absence of PSE incentives.

2.2.3.6 Schedule 258 Customers

A set of in-depth interviews with 11 of PSE's customers that are eligible for Schedule 258 revealed that remaining opportunities for energy efficiency projects do exist among these customers. The interviewer engaged the customer to talk about potential projects at their facilities by end use. As expected, much of the most cost-effective and technically simple measures have been implemented, but some opportunities do remain.

- **Lighting:** Almost no T12 lighting remains to be retrofitted. Customers still have lighting savings opportunities, but they are more costly and save less. Many customers mentioned controls for lights as future opportunities – occupancy, dimming and daylight harvesting. Conversion of high-bay HID lamps to fluorescent was mentioned for baseline energy savings and for the sake of integrating controls. One customer is considering HID dimming in conjunction with daylight harvesting where there are skylights. LEDs for exterior lighting are also an opportunity. Several of the sites were predominantly outdoor facilities with HID lighting.

» **HVAC:** Customers with Schedule 258 represent extremes with respect to HVAC use. Customers either have majority conditioned space or majority unconditioned space. In the former case, the customers have already invested in high-efficiency equipment and good controls. For these customers, retro-commissioning is seen as the best opportunity for savings. In the case where the HVAC load is small, it is neglected as an end-use. Machines are older and less efficient. These sites still have potential for improved HVAC equipment and controls, but this equipment is low priority and smaller.

» **Compressed air:** All industrial Schedule 258 customers recognize compressed air as a high energy user and most have taken steps to reduce costs. All perform leak surveys and most have variable speed compressors to match capacity to load with the least energy. There is interest among a couple customers to install more monitoring equipment on their compressed air systems to track air production and losses to optimize operation and preventative maintenance.

» **Drive power:** Almost all Schedule 258 customers have a policy of purchasing more efficient motors on burn-out. VFDs are used widely, but there is still considerable opportunity, especially on process equipment. Frequently motor projects require very fast turn-around for failed equipment, or they have a very long lead-time because the motors are part of a large-scale process change. Neither of these situations fit the Schedule 258 program well.

» **Refrigeration** was as significant load at very few sites interviewed. Optimum staging controls on compressors were the most often mentioned future project.

» **Server Virtualization**: Schedule 258 customers know their business. Where servers are a significant load, virtualization has been implemented, at least partially. The server equipment evolves quickly so there is an on-going turn-over of equipment to meet the customer's IT needs. Where the largest potential exists, there will also be the tendency to add additional capacity as the existing capacity is optimized; there are questions as to whether virtualization saves energy in these cases.

» **Building Shell:** Very few Schedule 258 customers felt that improvements to the building shell would be among future projects.

Navigant assesses that there is still significant, though diminishing savings potential among most end uses. The next tier of savings opportunities is more expensive, and the payback is longer. A few customers see the Schedule 258 funds as a mis-focused use of *their* capital that could be used for projects with a higher ROI than energy efficiency. Most, though, see the E258 funds as important seed money for projects with efficient alternatives and a way to leverage the installation of more efficient equipment – either in new projects or to replace burnt-out equipment – that might otherwise be only minimum efficiency.

2.2.4 Cross-Cutting Findings Regarding Progress and Opportunities at the Technology Level

This section presents results from two components of the analysis that look across all four priority sectors. By presenting the results for all priority sectors in the same section for these two pieces of analysis, higher level themes emerge in a more straightforward manner than if the data for each sector had been presented independently. These analyses include (1) the progress made to date and the remaining opportunities for specific technologies and (2) analyses that can help PSE better target its marketing activities from a geographic perspective.

2.2.4.1 Progress and Opportunities at the Technology Level

Results regarding progress to date and remaining opportunities in the priority technology categories are best examined across all sectors. The results are more meaningful when considering the relative opportunities across sectors because this approach presents PSE with the opportunity to assess the relative benefits of targeting outreach in the individual sectors. The analysis in the rest of this section presents the results to two key questions for each technology:

- What types of equipment were installed as part of previous <specific equipment> efficiency improvements?
- What <specific equipment> components do you think present the greatest efficiency improvement opportunities?

The analysis highlights the sectors in which remaining opportunities warrant additional attention by PSE.

Lighting retrofits are most broadly distributed across sectors and across specific technology types as seen in Table 2-12. All sectors report completing some type of energy-efficient lighting upgrades, and nine categories of technology-specific upgrades saw activity from at least five percent of respondents in at least one sector. The most popular lighting retrofit to date has been replacing or adding new fluorescent tubes, and this measure is also reported as having the most significant opportunity remaining. Multiple sectors report significant remaining opportunities for LEDs, CFLs, occupancy sensors, and electronic ballasts. By sector, the following findings are worth mentioning:

- Food Processors report the most significant remaining lighting retrofit opportunities in multiple areas.
- Five to eleven percent of the hospital respondents and of local government respondents indicate remaining opportunities for several technology types: occupancy sensors, CFLs, LEDs, pin-based halogen fixtures, and electronic ballasts.
- State government reports that concentrated opportunities remain for LEDs (38%), fluorescent tubes (19%), and occupancy sensors (4%).
- Offices report very limited remaining lighting opportunities with only three respondents identifying opportunities.

As shown in Table 2-13, hospitals have made the most progress on air conditioning retrofits, and they report the most significant remaining opportunities. The progress in the hospital sector is concentrated among a few types of air conditioning technologies, with hospitals reporting the most progress among central air handling equipment and central chillers; this latter category represents the greatest concentrated opportunity in any sector, with 44 percent of hospitals reporting that they know of remaining upgrades to central chillers.

All sectors report completing some type of energy-efficient upgrade on their air conditioning equipment although that progress is diffused among several technologies. Ten categories of technology-specific upgrades saw activity from at least four percent of respondents in at least one sector. Multiple sectors report significant remaining opportunities for controls, heat pumps, and variable frequency drives (VFDs). By sector, the following findings are worth mentioning:

- Hospitals report the most significant remaining retrofit opportunities in multiple areas.
- More than ten percent of state government respondents report opportunities in chilled water plants and heat pumps; eight percent report opportunities for controls.
- In the office segment, controls represent the greatest remaining opportunity, with 18 percent of respondents indicating some opportunity here.
- Local governments report very limited remaining air conditioning opportunities.

The best targets for additional data center retrofits are Hospitals and State Government. One-third of hospitals and 42 percent of State Government respondents indicated that they had data center facilities on-site. Respondents in both of these sectors indicated making previous investments in their data centers, including servers and storage devices (6 percent of hospitals and 15 percent of state government); various peripherals (11 percent/4 percent); and virtualization (6 percent/27 percent). Twelve percent of state government respondents also indicated that they had made changes to thermostat set points and other operational practices. Both hospitals and State Government report remaining opportunities across a range of technologies. Local Governments and Offices indicated that they are paying minimal attention to this end use; few opportunities remain.

Finally, gas space heating presents a strong opportunity in both the hospital and food processing sectors. About a quarter of hospitals report remaining opportunities in upgrading their boilers and/or controls. Nearly ten percent of food processors report remaining opportunities in their central furnaces, district steam systems, EMSs, or zone packaged heating units. A similar number of state government respondents (12 percent) report opportunities in upgrading their gas-fired central boilers, but this opportunity stands alone among state government agencies. Local governments and offices report a few scattered opportunities to upgrade their gas space heating equipment. Only a small portion of PSE customers report using electric space heating equipment, and a smaller fraction (14 percent) report many opportunities to upgrade this equipment further.

Table 2-12. Lighting Retrofit Progress and Remaining Opportunities

Technology	Replaced Already?					Opportunities Remain?				
	Hosp	FP	LG	SG	Offices	Hosp	FP	LG	SG	Offices
Daylighting controls/photocells	17%	0%	4%	0%	0%	6%	0%	0%	0%	0%
Energy Management System (EMS)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Occupancy sensors	22%	0%	13%	8%	0%	11%	18%	9%	4%	0%
Reflectors for delamping	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%
Replaced standard incandescent bulbs with CFLs	0%	18%	4%	0%	0%	6%	27%	9%	0%	0%
Replaced standard incandescent bulbs with LEDs	11%	0%	4%	12%	0%	11%	45%	4%	38%	0%
Replaced/added new fluorescent tube fixtures	44%	27%	9%	12%	59%	33%	27%	35%	19%	9%
Replaced/added new HID fixtures	0%	0%	0%	0%	0%	0%	18%	0%	0%	0%
Replaced/added new pin-based CFL fixtures	0%	0%	0%	0%	0%	0%	18%	0%	0%	0%
Replaced/added new pin-based halogen fixtures	0%	0%	0%	0%	0%	6%	18%	4%	0%	0%
Retrofitted/added (non-dimming) electronic ballasts	6%	18%	0%	0%	5%	11%	27%	4%	0%	0%
Retrofitted/added dimming electronic ballasts	28%	9%	9%	4%	0%	11%	18%	4%	0%	0%
Selective delamping	0%	0%	4%	8%	0%	0%	0%	0%	0%	5%
Time clocks	0%	0%	9%	8%	0%	0%	0%	4%	0%	0%
Number of responses provided	**24**	**9**	**15**	**14**	**16**	**18**	**24**	**18**	**23**	**5**
# of respondents to the question	**9**	**7**	**9**	**10**	**17**	**10**	**7**	**13**	**18**	**7**
# of respondents to the survey in this sector	**18**	**11**	**23**	**26**	**22**	**18**	**11**	**23**	**26**	**22**

Key: Hosp = Hospitals; FP = Food Processors; LG = Local Government; SG = State Government.
Source: Navigant and E&W survey with the Hospital, Food Processing, Local Government, State Government, and Offices sectors 2011.

Table 2-13. Air Conditioning Retrofits and Remaining Opportunities

Technology	Already Installed?					Opportunities Remain?				
	Hosp	FP	LG	SG	Office	Hosp	FP	LG	SG	Office
Built-up central air-handling equipment (changes to fans, volume controls, cooling and heating coils)	11%		0%	0%	0%	6%		0%	4%	0%
Central chilled water plant equipment	11%		0%	4%	0%	44%		0%	15%	0%
Cool roof replacing a standard roof	0%		0%	0%	0%	0%		0%	0%	0%
District chilled water piped in from outside the building	0%		0%	0%	0%	17%		0%	0%	0%
Economizer	0%		0%	0%	0%	0%		0%	4%	0%
Energy Management System (EMS)	0%		0%	8%	0%	6%		0%	4%	0%
Individual window or wall units (all components located in same housing)	6%		0%	0%	0%	0%		4%	0%	0%
NEMA Premium motors	0%		0%	0%	0%	6%		0%	0%	0%
Occupancy sensors	6%		0%	0%	0%	6%		0%	0%	0%
Packaged air conditioners or split-system air conditioners	0%		0%	0%	5%	6%		0%	0%	5%
Programmable thermostats	0%		4%	4%	5%	0%		0%	0%	0%
Reflective or tinted window film	0%		4%	0%	0%	0%		4%	0%	0%
Standard thermostats	0%		0%	0%	0%	0%		0%	0%	0%
Time clocks	6%		4%	0%	0%	0%		0%	0%	0%
Variable-frequency drives (VFDs) on large fan motors or chilled water pumps	6%		0%	0%	0%	11%		4%	0%	5%
Heat pumps*	0%		4%	0%	0%	0%		4%	15%	5%
Controls*	0%		0%	0%	5%	0%		0%	8%	18%
Number of responses provided	10		5	5	7	20		5	15	8
# of respondents to the question	7		4	4	6	15		8	11	8
# of respondents to the survey in this sector	**18**	**11**	**23**	**26**	**22**	**18**	**11**	**23**	**26**	**22**

Key: Hosp = Hospitals; FP = Food Processors; LG = Local Government; SG = State Government.
Source: Navigant and E&W survey with the Hospital, Local Government, State Government, and Offices sectors 2011.

Table 2-14. Data Centers Retrofits and Remaining Opportunities

Technology	Replaced Already?					Opportunities Remain?				
	Hosp	FP	LG	SG	Office	Hosp	FP	LG	SG	Office
Servers & storage drives – higher efficiency	6%		4%	15%	5%	6%		0%	15%	5%
Power supplies	0%		4%	0%	0%	0%		0%	0%	0%
Peripherals (various)	11%		0%	4%	0%	0%		0%	0%	0%
Heat recovery	0%		0%	0%	0%	6%		9%	0%	0%
Virtualization	6%		0%	27%	0%	0%		0%	15%	0%
Economizer/outside air free cooling	0%		0%	0%	0%	6%		0%	0%	0%
Other air flow management	0%		0%	0%	0%	6%		0%	0%	0%
Uninterruptible Power Supply (UPS) efficiency improvement	0%		4%	0%	0%	0%		0%	0%	0%
Thermostat set points & other operational efficiencies	0%		0%	12%	0%	6%		0%	0%	0%
Number of responses provided	4		4	15	1	7		2	1	1
# of respondents to the question	6		4	11		10		2	1	1
# of respondents to the survey in this sector	**18**	**11**	**23**	**26**	**22**	18	11	23	26	22
# of respondents with DC on site (DC0)	14	0	8	17	5	14	0	8	17	5

Key: Hosp = Hospitals; FP = Food Processors; LG = Local Government; SG = State Government.

Source: Navigant and E&W survey with the Hospital, Local Government, State Government, and Offices sectors 2011.

Table 2-15. Gas Space Heating: Progress and Remaining Opportunities

	Replaced Already?					Opportunities Remain?				
Technology	**Hosp**	**FP**	**LG**	**SG**	**Offices**	**Hosp**	**FP**	**LG**	**SG**	**Offices**
Central boiler	11%	4%	8%	9%	28%	28%	0%	4%	12%	0%
Central furnace	0%	9%	0%	0%	9%	0%	9%	4%	0%	0%
Designed Solar Technology	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
District steam or hot water piped in from outside the building	0%	0%	0%	0%	0%	0%	9%	0%	0%	0%
Energy Management System (EMS)	0%	0%	0%	0%	0%	0%	9%	0%	0%	0%
Higher-performance windows	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%
Individual portable propane heaters	0%	0%	0%	0%	5%	0%	0%	0%	0%	5%
Programmable thermostats	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%
Terminal Reheat (fan powered boxes)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Time clocks	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Variable-frequency drives (VFDs) on large fan motors or hot water pumps	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Zone Packaged heating units, including infrared heaters	0%	0%	0%	0%	5%	0%	9%	0%	0%	0%
Other building shell measures to reduce heating requirements	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Controls	6%	0%	0%	0%	0%	28%	0%	0%	0%	5%
Number of responses provided	5	3	2	6	8	14	10	5	3	4
# of respondents to the question	5	3	1	6	6	13	8	4	4	5
# of respondents to the survey in this sector	**18**	**11**	**23**	**26**	**22**	**18**	**11**	**23**	**26**	**22**

Key: Hosp = Hospitals; FP = Food Processors; LG = Local Government; SG = State Government.

Source: Navigant and E&W survey with the Hospital, Local Government, State Government, and Offices sectors 2011.

Table 2-16. Electric Space Heating: Progress and Remaining Opportunities

Technology	Replaced Already? Hosp	FP	LG	SG	Offices	Opportunities Remain? Hosp	FP	LG	SG	Offices
Central boiler			4%	0%	0%			4%	0%	5%
Central furnace			0%	0%	0%			0%	0%	0%
Packaged heating units (other than heat pump)			0%	0%	0%			0%	0%	0%
Individual space heater			0%	0%	0%			0%	4%	0%
Split-system heat pump			0%	0%	0%			13%	0%	0%
District steam or hot water piped in from outside the building			0%	0%	0%			0%	0%	0%
Terminal Reheat (fan powered boxes)			0%	0%	0%			0%	0%	0%
Energy Management System (EMS)			0%	0%	0%			0%	0%	0%
Time clocks			0%	0%	0%			0%	0%	0%
Programmable thermostats			0%	0%	0%			0%	8%	0%
Variable-frequency drives (VFDs) on large fan motors or hot water pumps			0%	0%	0%			0%	0%	0%
Designed Solar Technology			0%	0%	0%			0%	0%	0%
Higher-performance windows			0%	0%	0%			0%	4%	0%
Other building shell measures to reduce heating requirements			0%	0%	0%			0%	0%	0%
Number of responses provided	0	0	1	1	0	0	0	6	4	2
# of respondents to the question	0	0	1	1	0	0	0	6	6	2
# of respondents to the survey in this sector	**18**	**11**	**23**	**26**	**22**	**18**	**11**	**23**	**26**	**22**

Key: Hosp = Hospitals; FP = Food Processors; LG = Local Government; SG = State Government.
Source: Navigant and E&W survey with the Hospital, Local Government, State Government, and Offices sectors 2011.

2.2.4.2 Analysis Regarding Geographic Targeting of PSE's Marketing and Outreach Efforts

PSE sought input on two specific issues related to customer location – level of customer awareness of PSE's energy efficiency programs and the capital investment plans. Understanding how these issues vary by location can help PSE determine if marketing efforts focused on specific geographic areas can increase customer engagement in the programs.

Figure 2.46 depicts the findings regarding level of customer awareness. The red symbols indicate the respondents that indicated almost no awareness of PSE programs; the green symbols represent respondents that may have indicated some or high levels of awareness of PSE programs. Each shape represents a different sector as described in the Key.

Respondents located throughout the service territory report low levels of awareness. A few areas (which represent a combination of gas, electric, and combined customers) demonstrate lower levels of awareness.

- » the Lewis County-Grays Harbor County area
- » in and around Tacoma
- » near Bellingham (though other parts of Whatcom county report relatively higher levels of awareness)
- » I-5 corridor in western King County south of Seattle
- » respondents near Olympia report mixed results, with about half reporting almost no awareness.

Figure 2.47 depicts respondents' feedback regarding their plans to invest capital in their facilities in the next two years. Red symbols indicate no plans for capital investment in the next two years, while green symbols indicate plans to invest capital in the facility in the next two years. Each shape represents a different sector as described in the Key.

Plans to invest capital also vary throughout the region. Table 2-17 lists the areas in which there are higher and lower concentrations of customers that plan to make capital investments in their facilities in the next two years.

Table 2-17. Customer Plans to Invest Capital in Facilities in Next Two Years

Higher Concentration of Planned Capital Investment	Lower Concentration of Planned Capital Investment
Tacoma	Lewis County-Grays Harbor County area
Seattle	Most of Whatcom County, including Bellingham
Bellevue (generally speaking)	I-5 corridor in western King County south of Seattle
	Olympia

Source: Navigant analysis of E&W survey of PSE customers 2011.

PSE may consider targeting trade allies in the Tacoma area with additional information about PSE's energy efficiency programs. Facilities in that area report higher likelihood to invest capital in their facilities in the next two years and also indicate that they are "not at all aware" of PSE's incentive programs. Other areas with very low levels of awareness about PSE programs do not represent such strong targets as Tacoma because they have higher concentrations of facilities that do not plan to invest capital in the next two years.

Figure 2.46. Levels of Customer Awareness of PSE's Energy Efficiency Programs by Sector and Location

Source: Navigant analysis of E&W survey of PSE customers 2011.

Figure 2.47. Customer Plans for Capital Investment in Next Two Years by Sector and Location

Source: Navigant analysis of E&W survey o f PSE customers 2011.

2.3 *Opportunities for PSE Involvement*

This section outlines a set of options for PSE's involvement in the market for energy efficiency retrofits in its target C&I market sectors. It builds on the previous sections, which outlined the market framework within which these sectors operate, key trends in the market, and the recent developments in each of the priority sectors that affect decisions about energy efficiency.

At this time, this section provides a high-level discussion of recommendations based on the completed data collection activities to date. At this time, those data collection activities include interviews with market actors, end user surveys, as well as the literature review and much of the secondary research. These findings provide a starting point for discussion at the upcoming in-person meeting between the evaluation team and PSE.

This section presents two options for PSE's involvements at two levels. First, Section 2.3.1 includes a discussion of the overarching themes – those that apply to all of the sectors. Section 2.3.2 summarizes the key sector-specific themes for PSE's involvement in the priority sectors.

2.3.1 Overarching Themes

Some themes that may influence PSE's involvement in the market for energy efficiency retrofits in C&I markets cut across all sectors. The discussion below identifies some of the key considerations for customers that can improve the success of outreach to customers, suggestions for the approach to marketing the programs, and two specific technology opportunities that PSE may consider promoting in the near- to mid-term.

2.3.1.1 Key Customer Considerations

Considering the broader business issues faced by customers can help PSE design programs that reach the customers more effectively. In the current economic climate, three considerations are key:

- **Sector conditions:** Each sector faces unique challenges in today's business climate. The discussion in Section 2.2.3 provides an update on what some of those challenges are and how they affect energy efficiency decisions. PSE can leverage this initial information and its relationships with service providers to continue to monitor developments in these sectors that will affect program participation. This will enable PSE to adjust program offerings to take advantage of fluctuations in the market.
- **Capital budgeting cycles:** The capital budgeting cycle is a key factor in the timeline for approving a project. This is especially true during periods of constrained capital, as organizations struggle to stretch their dollars further and protect the assets that they already have. Understanding the timing of capital budgets and how organizations make decisions can help PSE to maximize the effectiveness of its outreach efforts. For example, targeting key outreach events before and during the preliminary phases of capital budgeting can yield greater returns because decision makers have not yet allocated their capital and are more open to new opportunities.
- **Balance sheet strength:** Balance sheet strength varies by organization, but understanding the trends at the sector level has important program design implications. Balance sheet strength has important consequences for the types of gaps that organizations need to fill in order to complete

energy efficiency projects. Those with weaker balance sheets may require a partnership with an ESCO in order to raise the capital to complete the project. Those with stronger balance sheets may require more education of key decision makers. As PSE designs its offerings, the consideration of balance sheet strength at the sector level will provide guidance for how to impact the sector most effectively. The Dow Jones Industrial Average (DJIA) provides a high-level snapshot of performance at the sector level; variation is expected to exist within each sector, but the representatives used in the DJIA serve as reasonable proxies for the sector as a whole.

The knowledge gained through the **Resource Conservation Manager (RCM) program** can supplement the information in this report and the input from service providers. RCM provides a unique opportunity because of the proximity of the interface between the organization and PSE. RCM participants in the key sectors can provide insight into these issues through a unique lens. Discussions with RCM participants from the key sectors – either in one-on-one situations or in focus groups – can help PSE adjust its offerings at the programmatic level to improve the programs' match with sector needs.

PSE may consider examining **on-bill financing** offerings in more depth in response to some of the needs at the sector level. This approach has proven useful in other service territories in bridging the gap between available capital resources and the resource needs of a given project. PSE may consider shifting the risk of the financing to a third party and simply serving as an administrator of the payment through its billing system. A variety of considerations will affect the viability of this option; Table 2-3 above includes four utilities' approaches to addressing some of the key risks associated with on-bill financing.

2.3.1.2 Marketing Considerations

Effective marketing of the programs can enhance program participation. The channels selected for outreach affect the credibility of the message and the customers' response to it in many cases. In addition, the messages used to promote the programs will affect how customers consider the program in light of their other business priorities.

PSE is already working with a strong set of service providers and internal partners to promote its programs. Building on those efforts, PSE may consider the following approaches to reach its customers more proactively:

» **Trade ally strategy development.** PSE's trade allies are some of the most important channels for outreach to PSE's customers. PSE can educate them about PSE's programs, train them on the technologies and services that are eligible for PSE incentives, and provide them with the tools necessary to market the programs to their customers. The investment of these resources is multiplied many times if the trade allies are effective as channel partners. PSE may consider reviewing its approach to working with trade allies and develop a formal strategy for leveraging them in the future. The strategy should include a high-level view of the value proposition that PSE brings to the trade allies and the value proposition that the trade allies bring to PSE; a statement of the goals of partnership; benchmarks for implementation; and an owner for each key component of the trade ally strategy.

» **Account representatives and account managers.** These individuals have direct lines of communication with PSE's largest customers. These relationships can lead to great insights into customers' needs and priorities. In many cases, these PSE representatives are considered trusted advisors to their customers. Ensuring that all of PSE's account representatives and managers are well versed in the benefits of energy efficiency and PSE's offerings will enhance their abilities to expand participation in the program. If it is not already the case, PSE may consider creating incentives (financial, performance-related, or other) for these individuals to convince their customers to complete energy efficiency projects.

» **NEEA's partners.** NEEA has developed strong ties with market actors in the office, hospital, and food processing sectors. These include industry organizations, contractors, decision makers, and others who can (1) enhance PSE's understanding of these markets and (2) create opportunities to share PSE's program offerings with their constituencies and customers. Working with NEEA to access these partners will expand on PSE's existing relationships with key market actors.

» **New account communications.** Transitions such as relocations lead to changes in behavior that create opportunities for energy efficiency programs. Reaching out to new customers during this time of transition may enable them to see the benefits of PSE's programs from a different perspective than when they are steeped in their business-as-usual activities. Information in a mailer or a phone call to the customer during this time can form a foundation that other program activities can build on later.

» **Nearby utilities.** PSE can leverage its own marketing efforts and funds by partnering with utilities within and around its service territory. Some of these utilities focus on some of the priority sectors identified in this report. Coordinating outreach on these programs may create a more cohesive message to the sector across the region as well as to the companies that serve these sectors.

PSE may consider three key messages in its marketing efforts:

» **Energy is a variable cost reduction opportunity.** Some sectors have just recently begun to identify energy as a variable cost rather than a fixed cost. This is a powerful message in a time of tight budgets that drive the need for cost reductions. For many years, businesses considered energy a fixed cost; as such, it was not a subject of conversation when the need arose to reduce costs. This is still the case in many sectors, but it is changing slowly. Accelerating the pace of that messaging may spur broader participation in PSE's programs.

» **Energy efficiency helps to promote a "green" business image.** As more companies incorporate "green" messaging into their marketing strategies, they become more open to suggestions about how to enhance the sustainability of their business. Renewable energy, organics, and recycling often come to mind before energy efficiency. Helping decision makers to understand that energy efficiency can fit into this strategy can help to deepen market adoption. The media's coverage of best practices and case studies, whether they occur in Seattle or elsewhere around the country, can also assist in building awareness about the positive effects (energy- and non-energy related) created by these investments.

In addition, PSE may consider creating targeted marketing approaches for each of its priority sectors. These marketing approaches would rely on internal expertise regarding each sector's market structure and decision-making processes. In some sectors, this expertise may already exist within PSE; in other sectors, PSE may need to supplement its existing knowledge. PSE uses this approach with the Energy Smart Grocer program, which relies on a third party with deep experience in the sector to build relationships, influence decision makers, and design incentives with the most impact. PSE may consider a similar approach in its other target sectors.

2.3.1.3 Technology Considerations

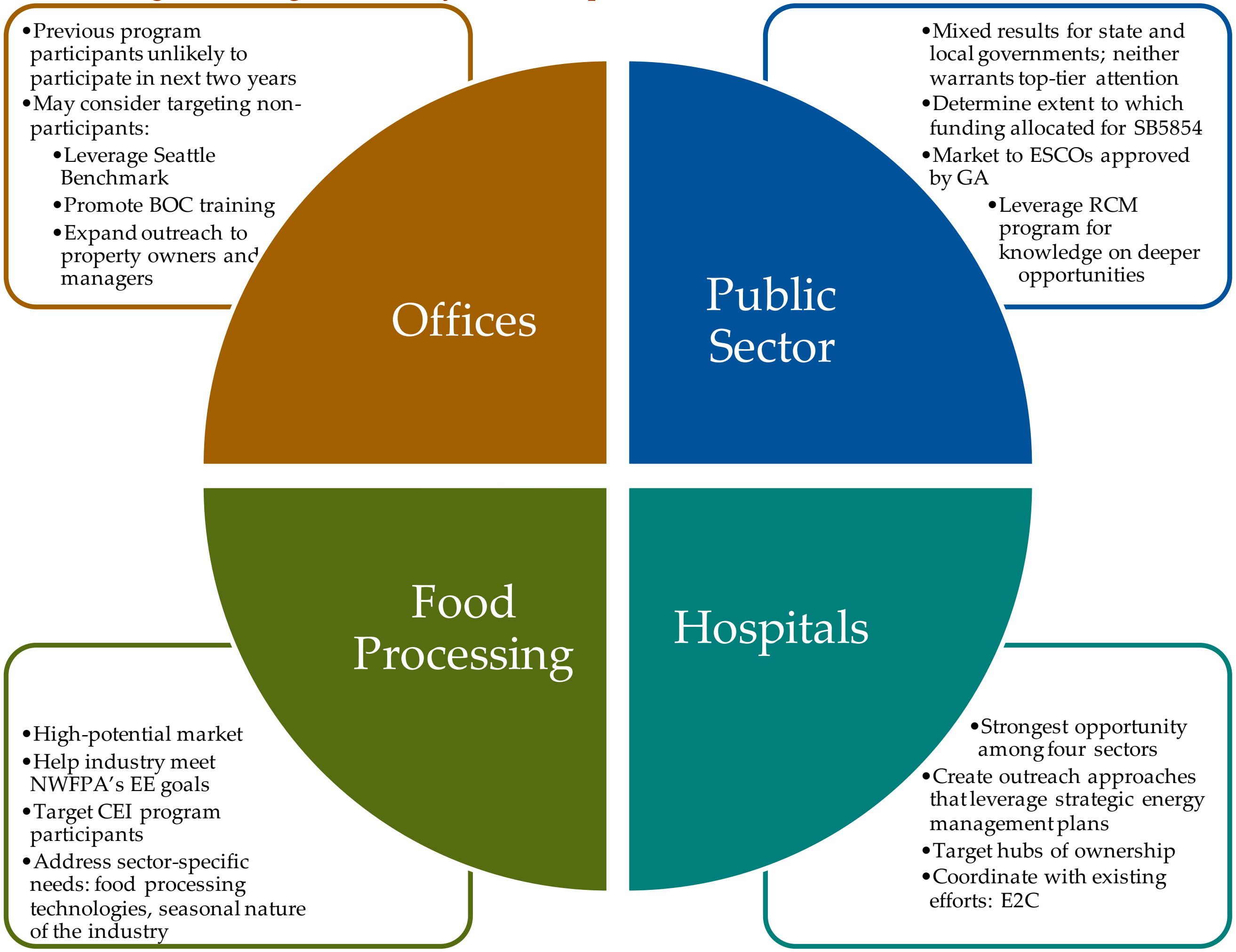
As discussed in Section 2.2.2.3, the market is moving more heavily toward LEDs and building automation systems. Specific uncertainties about these technologies still persist in the energy efficiency community, but the market has moved past these uncertainties and is implementing projects with these technologies. They pose significant opportunity for future energy savings if PSE decides to promote them. Developing a plan for vetting these technologies – both internally and in the region as needed – will open new opportunities for PSE to count energy savings in the region.

2.3.2 Sector-Specific Themes

This section outlines sector-specific opportunities for PSE to consider in the design and implementation of its programs. They address unique characteristics of each sector and take advantage of unique opportunities available in each sector. These are organized in the same order in which they were presented earlier: offices, public sector, hospitals, and food processing.

Figure 2.48 summarizes the sector-specific approaches suggested in the remainder of this section.

Figure 2.48. Figure Summary of Sector-Specific Market Evaluation Recommendations



Source: Navigant analysis 2011.

2.3.2.1 Offices

Previous participants in PSE's incentive programs from the office segment represent the weakest segment of the four investigated for additional targeting by PSE. This segment is challenged economically, with only half of the facilities planning to invest capital in the next two years. They report very narrow bands of remaining opportunity for energy efficiency, with only controls reported by more than 10 percent of respondents as a remaining opportunity. While this segment does have high levels of owner occupancy and substantial facility size, the ownership's receptivity to additional investment overshadows those favorable factors.

Offices

- Previous program participants unlikely to participate in next two years
- May consider targeting non-participants:
  - Leverage Seattle Benchmark
  - Promote BOC training
  - Expand outreach to property owners and managers

PSE may consider further investigation of the market for offices that have not previously participated in PSE programs. Although their capital investment plans may mirror their participating counterparts, more energy efficiency retrofit opportunities likely exist. This segment is challenging to define for market research opportunities, but PSE may consider developing proxy representation, such as using NAICS codes that represent sectors that frequently occupy office space (e.g., computer software, engineering, and services firms).

In the event that PSE chooses to pursue non-participating office customers, much of the market assessment work conducted for this project can be applied. PSE can leverage the efforts that other market actors have already initiated to deepen penetration of energy efficiency in the offices sector. These efforts include the City of Seattle's benchmark, building Operator Certification (BOC) training offered by NEEC and IBOA, and the development of relationships with industry associations and building owners that NEEA has fostered in the past decade.

First, the benchmarking requirement in the City of Seattle creates opportunities for gas customers directly affected by the policy and for other customers that will be indirectly affected. **For customers required to benchmark their facilities,** PSE can strengthen its promotional efforts during key reporting periods. Some buildings could improve their performance in the benchmarking by making upgrades to some equipment; they may be inclined to do so in advance of their initial report to improve the position of their property in the marketplace. PSE could run a marketing effort targeted at those facilities (and their owners) in advance of the first reporting period (October 2011 or April 2012, depending on building size). PSE may also consider increasing its incentive levels during these times to provide additional motivation to complete projects.

For facilities in cities and towns near Seattle, PSE may consider working with market actors to help identify facilities that compete with Seattle-based facilities for occupants. To the extent that prospective tenants begin to expect energy benchmarking reports when they evaluate potential facilities, PSE may consider promoting benchmarking capabilities of service providers. One way of accomplishing this would be to certify benchmarking firms and sharing that list with building owners throughout the service territory. An alternative would be to offer a modest incentive to assist in paying for the benchmarking. Either of these efforts may help to increase the number of facilities that consider retrofits as a means for improving their performance relative to other buildings.

PSE may consider expanding its support for certification of building operators in its territory through the **BOC** program. PSE currently offers a stipend for such certifications through its Resource Conservation Manager program. The BOC training achieves approximately 119 MWh of savings per building operator per year.[91] PSE may be able to claim credit for this initial training, and it may also serve as a point of entry to the building operators. Once they have received the training, the building operators may seek incentives to support some of the improvements that they would like to make.

Finally, property owners and managers of different sizes likely present different opportunities for PSE's programs. Service providers indicate that the **largest property owners and managers** have already implemented many of the measures with the shortest payback cycles. Additional opportunities in this segment will have longer payback periods and may not meet the thresholds currently established by these firms. One option is to help make connections between ESCOs and office property managers and owners to help overcome this barrier. Alternatively, PSE may consider leveraging the benchmarking requirements (as described earlier) to make the business case for going deeper with the energy efficiency investments in this segment.

On the other hand, **mid-size office property owners and managers** likely have significant opportunities for projects remaining. Service providers did not indicate that this segment had been targeted as heavily as the largest segment of the market. In fact, one service provider indicated that it was targeting mid-size office buildings (three to ten stories) because of the opportunities in this sector. PSE could work more directly with the property owners and managers in these mid-size buildings to increase awareness of PSE's incentives and to connect them with service providers.

2.3.2.2 Public Sector

The public sector represents a possible target for additional targeting for PSE but not the strongest of those explored for this project. The dynamics differ at the state and local levels:

- More state government agencies (54 percent) report the intention to invest capital in their facilities in the next two years than local governments (28 percent).
- Local governments (96 percent) report higher levels of owner occupancy than state governments (29 percent).
- State governments represent a better market for upgrades across the three major technology categories (lighting, air conditioning, and data centers) than local governments.

[91] NEEA has used this estimate for its Long-Term Monitoring and Tracking (LTMT) efforts in the past. The 2011 LTMT effort will seek to refine this estimate through surveys with program participants and non-participants.

Public Sector

- Mixed results for state and local governments but neither warrants top-tier attention
- Determine extent to which funding allocated for SB5854
- Market to ESCOs approved by GA
- Leverage RCM program for knowledge on deeper opportunities

Additional targeting of the public sector should proceed with caution in regard to the availability of capital. ARRA funds drove the recent boom in energy efficiency in this sector over the past two years. The legislature passed the state's capital budget for the 2011-13 planning period, but it is not clear whether or not it directed funding at meeting the energy goals established in SB 5854. At the same time, local governments are struggling to maintain their credit ratings and may not have the bandwidth to either raise capital themselves or to take on additional long-term liabilities in the form of loans or capital (e.g., on-balance sheet) leases.[92] There is some uncertainty about the rate at which this sector will continue to adopt additional energy efficiency projects in the coming years.

In the event that these issues are resolved, PSE may consider partnering with the GA's program for approving ESCOs. PSE may consider distributing material or holding training for the approved ESCOs to familiarize them with PSE's offerings. Although many of the ESCOs currently approved already participate in PSE's programs, several mentioned that it is difficult to keep up to date with the changes in incentives. Increasing engagement even modestly may go a long way towards increasing participation in the programs.

Further, PSE may leverage the expertise developed by participants in and staff of the RCM program. The proximity in which this program works with public sector customers provides access to information and insights that are not as widely available in the other priority sectors. Hosting focus groups or leveraging personal relationships may provide deeper insight into the approaches used to target this sector.

2.3.2.3 Hospitals

Hospitals represent the strongest opportunity for energy efficiency upgrades among the four sectors identified because of the economies of scale and favorable investment conditions. They **universally own and occupy** their facilities, and their large facilities provide fertile ground for identifying bundles of measures at one facility. Nearly 90 percent of hospitals have plans to invest capital in their facilities in the next two years, which implies that funds may be available for energy efficiency.

Like the office sector, PSE can achieve deeper penetration of energy efficiency by targeting the **concentrated ownership** in the hospital sector. Ownership of hospitals is concentrated among a relatively small number of organizations, creating opportunities to reach multiple facilities with outreach to a single entity. Connecting with these few entities will require a deep understanding of decision-making processes at hospitals and the priorities that drive those decisions.

[92] U.S. EPA. October 2008. "ENERGY STAR Building Upgrade Manual." Environmental Protection Agency. (http://www.energystar.gov/ia/business/EPA_BUM_Full.pdf)

Opportunities in the hospital sector can leverage previous efforts at NEEA and existing industry partnerships. The **strategic energy management plans** that hospitals have developed through these initiatives provide a head start for working with this sector. Many of the hospitals in PSE's service territory have already completed these plans. If PSE does not already have a list of these hospitals, PSE may consider working with NEEA to obtain this list to facilitate marketing efforts. Several service providers indicated that they are already targeting this sector, but more may choose to do so if they are aware of the planning that this sector has already completed. PSE may work to raise awareness about these efforts among the service provider community; PSE may consider working on its own or in conjunction with its neighboring utilities and the E2C initiative.

Hospitals

- Strongest opportunity among four sectors
- Create outreach approaches that leverage strategic energy management plans
- Target hubs of ownership
- Coordinate with existing efforts: E2C

Further, hospitals report significant opportunities across several technology categories. **About 84 percent of respondents indicate opportunities to retrofit their air conditioning units**, with central chillers receiving the most attention. More than half (55 percent) report opportunities to retrofit lighting, with the replacement or installation of new fluorescent fixtures the most popular option. A similar number report opportunities to upgrade on-site data centers.

Since the sector is already aware of energy efficiency as an opportunity, a practical approach to overcoming common hurdles may help to create implementation opportunities; case studies that demonstrate other hospitals' approaches to overcoming those hurdles would provide one approach to doing so. Other approaches may include leveraging the expertise of trade allies or an industry veteran to communicate the success stories or to troubleshoot at the organizational level. PSE may also consider addressing the sector's low level of awareness about the role of energy costs in overall facility operating costs through education and deeper engagement on the strategic energy management plans.

2.3.2.4 Food Processing

The food processing sector is poised for further engagement with PSE. This is a high-potential market because the **industry itself is creating the demand** for additional energy efficiency investment. The sector's energy use intensity reduction goals create the point of entry for PSE, and individual firms' strategic energy management plans create key starting points for discussion. More than half of food processors report having participated in PSE programs in the past, providing a strong foundation for soliciting deeper participation in the future. PSE's outreach efforts may focus on approaches to achieving the goal at the industry level as well as those goals established by individual firms.

Further, the food processing sector **has the economic motivation and the economic resources available** to invest in energy efficiency. More than half of food processors report that **energy costs represent six percent or more of their overall operating costs**, meaning that reductions in energy efficiency translate into bottom-line benefits. Since **financial returns are the primary driver for energy efficiency investment**, this noticeable effect on the bottom line strengthens the case for energy efficiency. Since they tend to own their own facilities (nearly three-quarters do), they reap the benefits of investing in energy efficiency in their own facilities. Further, about **three-quarters of food processors indicate that they will invest capital in their facilities in the next two years**. Together, these financial motivations create an investment environment that is amenable to energy efficiency.

Food Processing

- High-potential market
- Help industry meet NWFPA's EE goals
- Target CEI program participants
- Address sector-specific needs: food processing technologies, seasonal nature of the industry

The food processing sector has identified opportunities for additional investment in energy efficiency. Nearly 20 percent of respondents identified opportunities for future lighting retrofits across a suite of technologies, and 45 percent identified replacements of standard incandescent with LEDs as a remaining opportunity. Over **80 percent** of respondents indicated the **opportunity for retrofitting at least one food processing-specific technology**; process refrigeration/freezing and materials handling/conveyor motors were the two categories listed most frequently.

Engaging more deeply with NWFPA is a natural first step. It represents about one-quarter of the food processing facilities in the region and has the relationships and stature in the industry to create opportunities for PSE. If PSE is not already a **Supplier member** of NWFPA, PSE may consider joining in this capacity; such a membership would provide PSE with access to the membership lists, which include both facilities and service providers. These lists could help PSE further target its market efforts. The partnership with NWFPA may include efforts to **promote the pilot projects** that NEEA and its partners completed.

If PSE chooses to make the food processing sector a focus, PSE may emphasize the importance of **enhancing internal expertise** on the structure and decision making within this industry. The seasonal nature of the food processing industry creates unique challenges not faced in the other priority sectors. Developing strategies to overcome the challenges to capital allocation and to the sales cycle would support energy efficiency efforts in this sector and strengthen relationships with service providers.

3 Process Evaluation

This section discusses Navigant's process evaluation methodology, findings and recommendations regarding the efficiency and effectiveness of PSE's Schedule G205, E250, E257 and E 258 programs.

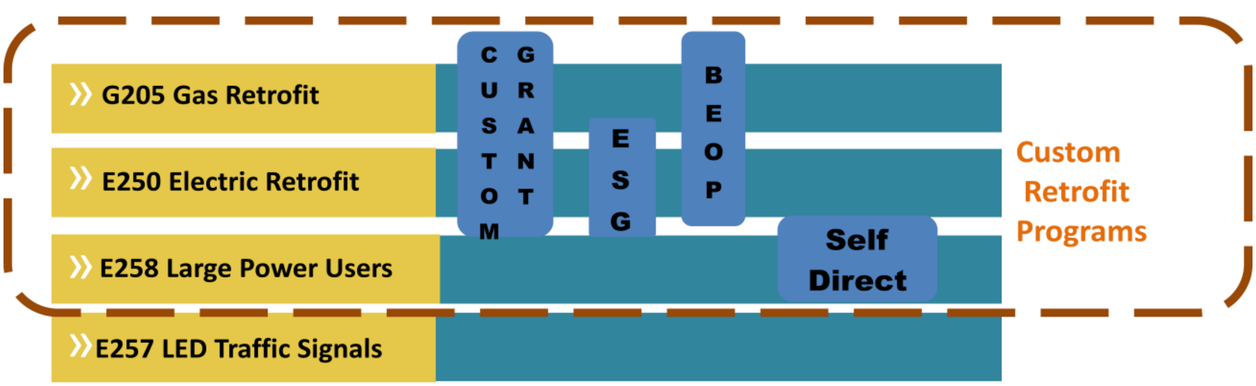
3.1 Methodology

This process evaluation is designed to provide PSE with the information that it needs to enhance its C&I EE retrofit programs' design, marketing and delivery processes and to enable PSE to increase the savings achieved through its C&I retrofit programs. This evaluation effort encompasses the four schedules – G205, E250, E257, and E258 - but is structured around how the schedule-funded programs are designed and delivered to customers. Specifically, Navigant's process evaluation assesses the following five programs, some of which match one-to-one the funding schedule and some of which overlap multiple schedules:

- Custom Grant Program
- EnergySmart Grocer (ESG) Program
- Building Energy Optimization Program (BEOP)
- Large Power User Self-Direct (Self-Direct) Program
- LED Traffic Signals Program

The overlap between the funding schedules and the customer facing programs are depicted in Figure 3.1.

Figure 3.1. PSE Custom Retrofit Programs and Funding Schedules Evaluated by Navigant



The process evaluation addressed the following key research questions regarding these programs:

» Are the programs being operated effectively and efficiently?

» How can the programs' operations and impacts be enhanced?

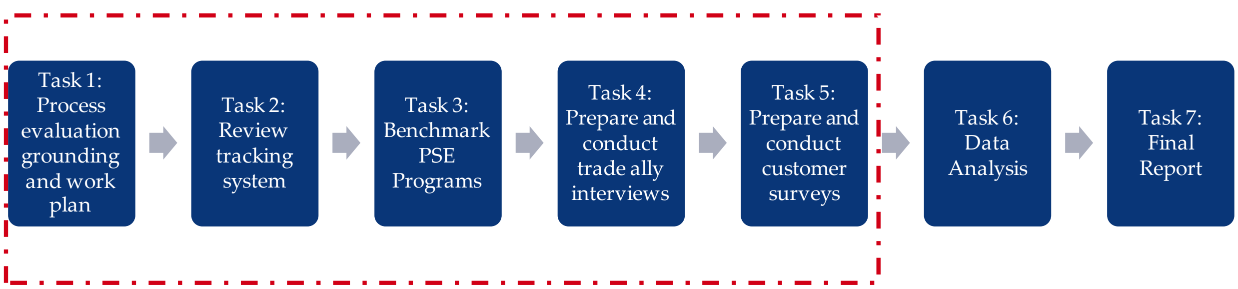
» How can underserved customers be better reached?

» How can deeper savings best be obtained?

» What levels of free-ridership and spillover are occurring?

The process evaluation relied on five key data collection activities, which are shown in Figure 3.2 and discussed in the balance of this section. The five data collection steps include PSE staff interviews (included in Task 1 Process evaluation grounding), logic model development (also in Task 1), participant data mining (part of tracking system review), PSE program benchmarking against peer programs, trade ally in-depth interviews and customer surveys. Navigant expanded the planned data mining beyond participant data to include some analysis relative to PSE's entire C&I customer population, although this effort was not included in the original work plan.

Figure 3.2. Process Evaluation Activities



In addition to addressing the above research questions, Navigant has strived to enumerate specific opportunities by which PSE may enhance its efforts to generate additional savings through these programs. This report details actionable recommendations for PSE staff using the Process Evaluation Team's data collection efforts and analysis to support the recommendations.

3.1.1 Program Management In-Depth Interviews and Document Review

Navigant interviewed twelve PSE staff as well as a director of PECI's EnergySmart Grocer program. PSE staff interviewed included engineering staff, program managers and four marketing and sales staff representing major account executives, business segment managers, marketing communications and Energy Advisor staff. These interviews supplemented impressions drawn from program documents and informed the logic models that Navigant developed (Appendix E). In turn, the logic models shaped subsequent staff interviews as well as the interview and survey guides for trade allies and customers. These interviews also provided input to Navigant's tracking system review.

Perhaps most importantly, the staff interviews provided input on potential issues and opportunities related to program design and delivery, as well as the history and fundamental understanding of the programs' present status. This initial input regarding potential issues and improvement opportunities helped shape Navigant's subsequent research.

3.1.2 Mining of the Program Tracking System and Commercial and Industrial (C&I) Customer Database

Navigant obtained data extracts for the four funding schedules from PSE's program tracking systems to glean information about the programs' performance and activity. Navigant subsequently requested both an extract and an analysis (by rate schedule) of the C&I customer database to assess the two years' program participation and savings relative to PSE C&I activity as a whole. Navigant cleaned and mapped the program tracking data on participants and trade allies. Some targeted data was not available from the databases, but the quantity of missing data was limited and did not affect the quality or reliability of the findings.

Mining of the 2009/2010 program data and the C&I customer database provides a two-year snapshot of how the program is doing in attracting participation and garnering savings. This analysis drilled down to assess *premise* level participation by consumption tier (based on rate schedules) and business type (based on NAICS codes in the C&I customer database.) It also reviewed the custom retrofit activity from a range of perspectives: premise type participation, measure type and quantity implemented, average project size, incentive amount and cost per first year kWh saved, and trade ally activity. Several of these metrics were analyzed at the program level. Navigant's draft data mining results memo is attached as Appendix F.

PSE's programs in most cases have been running for a number of years consistently meeting or exceeding savings targets. . The program data analyzed for this report only covers two years and therefore does not reflect full program saturation. This analysis does, however, provide a picture of two years' activity and the approximate current annual savings rates, which have predictive value for future years if no programmatic changes are made.

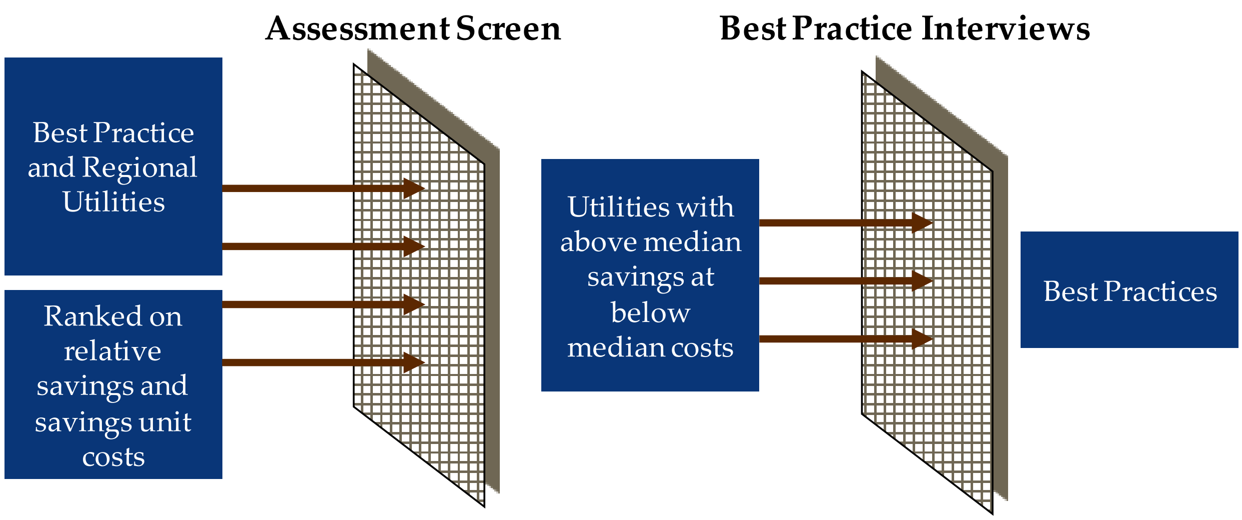
3.1.3 Benchmarking of Best Practice and Regional Electric and Gas Utilities

Navigant collected published 2009 data on regional electric and gas utilities' C&I EE programs as well as utility programs previously identified by Navigant as best practice utilities at the C&I EE program *portfolio* level. The team collected data on C&I DSM program spending, savings from C&I DSM programs and total utility C&I electricity and gas consumption and revenues. Savings *costs per first year kWh and Therm* were broken down by incentive and non-incentive spending where available. The team also collected data on average per kWh and Therm *retail rates* to understand the energy cost environment for the utility's customers.

The benchmarked utilities were then ranked based on a combination of their 2009 C&I program cost per first year kWh saved and percent C&I program savings relative to total C&I kWh or Therm consumption. The top performing utilities generated above average savings at below average first year cost per kWh or Therm saved. Based on these rankings, Navigant staff then interviewed higher savings/lower cost custom retrofit, Smart Grocer and commissioning program operators to learn about their programs and about other programs they had in place to achieve the deeper savings at lower cost. (Figure 3.3).

Navigant has also drawn on its experience with other utilities to highlight other best practices that could prove useful to PSE. The draft benchmarking and best practices report is provided in Appendix G.

Figure 3.3. Navigant Utility EE Program Benchmarking and Best Practices Development Approach



The team recognizes that program comparisons are not always apples-to-apples. While Navigant's reported program savings are adjusted to reflect gross values at the generator, there are many other variables that cannot be adjusted to make the savings or costs more comparable. Energy codes vary and with them the associated savings from any measure. In addition, how utilities account for DSM program costs varies. Some programs have greater relative funding, while others have been operating longer, with the attendant benefits and challenges. *This benchmarking analysis is not designed to pick winners and losers, but rather to identify utilities and programs that may be garnering more savings with less funding and in turn may have an approach that will enable PSE to do more with their current funding and staffing.*

3.1.4 In-depth Interviews with Trade Allies

The Navigant Process Evaluation team conducted in-depth interviews with 25 trade allies as detailed in the Team's memo "Process Evaluation – Approach to Sampling Trade Allies" dated March 25, 2011. (Appendix H) Over a one-month period spanning April and May 2011, Navigant interviewed 25 trade allies as detailed in Table 3-1.

Table 3-1. Composition of C&I Custom Grant Trade Ally Interviews

Trade Allies	Stratification	Number of Interviews (25 Total)
Most Active	By type for coverage	7 participants
Moderately active	By type	6 participants
Least Active	By type	4 participants
Commissioning	Most active and inactive	3 participants/2 inactive qualified agents
EnergySmart Grocer	Most active	3 most active participants
Not active	Targeted by sector	None

Navigant attempted to identify and interview inactive trade allies but was unable to identify any credible candidates. Virtually all trade allies contacted either participated in PSE's programs or were not active in the commercial or industrial sectors. Over 500 trade allies participated in PSE's custom retrofit programs over the past two years, suggesting that the majority of those trade allies qualified to participate are already active. BEOP providers were one exception to this rule and Navigant conducted two interviews with those inactive agents. In place of the planned non-participating trade allies, Navigant interviewed additional active trade allies. PSE reviewed and commented on the Team's interview guide (Appendix I)

The *trade ally interviews* were designed to obtain the following:

» Feedback on delivery strategy, target market, eligible measures, incentive structure, grant process, spillover and other program aspects.

» Perceptions of the programs' design and delivery effectiveness and efficiency.

» Input on how they promote (or can promote) each program they are involved in and their motivation(s) for participating or not participating.

» Comments on whether/why some of their customers are not interested in participating and what can be done to increase participation levels.

» If the trade allies are not marketing PSE's programs to some of their customers, why that is the case.

Navigant analyzed the 25 trade ally interview results and key findings are conveyed in more general terms such as "many", "a few" or "most". In-depth interviews by their nature are not designed to provide statistical data but rather to investigate individual trade ally views of the program. Follow up questions in the trade ally interviews were shaped by the quantitative findings from the other research streams along with prior experience with C&I custom retrofit programs.

3.1.5 Customer Surveys

The customer survey of the Process Evaluation Team's review of PSE's custom grant programs involved obtaining feedback from program participants, partial participants (customers who started but did not complete the program process to obtain a grant) and non-participants (customers who did not participate in the two-year period evaluated, 2009 and 2010.) This customer feedback is useful primarily in addressing a particular subset of the overarching process evaluation questions, specifically in the following areas:

- Assessing participant satisfaction with the programs
- Identifying areas with opportunity for improved efficiency
- Understanding key barriers to program participation
- Highlighting potential foci for market and outreach strategies and messages

PSE program management identified light manufacturing and commercial real estate firms as potentially underserved customer segments. Where sensible, the team's findings break out responses from these two customer types. Because the sample sizes of these two customer types are quite small, their findings should be considered qualitative and additional research may be warranted.

As detailed in the evaluation team's sampling approach memo (Appendix H), feedback was qualitatively stratified to reflect different customer types, sizes, and activity levels in line with the PSE program management perceptions of underserved customer groups and underperforming programs. In addition, findings specific to different programs funded by the same schedule have been collected separately where the program processes are different, such as the EnergySmart Grocer (ESG) and Building Energy Optimization Program (BEOP).

Navigant's analysis first extracts the findings from each of the research streams and then weaves together the findings and conclusions from all of them to create a full-faceted view of PSE's custom retrofit programs' efficiency and effectiveness.

3.2 Findings

The process evaluation findings in this report are organized around both the four Schedules and five programs funded by the Schedules since *process evaluation has a number of components which are program-specific*. This report is organized to first provide findings that apply to all five programs or to the custom retrofit programs in aggregate, looking at electric and gas findings separately. Then program-specific findings are provided for the following programs and schedules:

» Custom Grant Program Without ESG and BEOP

» ESG Program

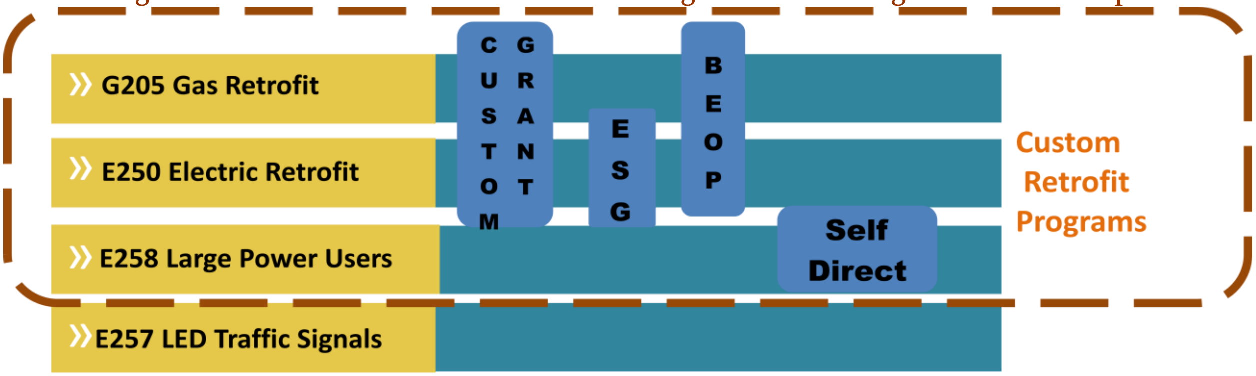
» BEOP

» Self-Direct Program/Schedule 258

» LED Traffic Signals Program/Schedule 257

Figure 3.4 presents for reference again the schematic of the overlay of programs and schedules. This schematic will also be provided to orient the reader at the beginning of each findings section.

Figure 3.4. PSE Custom Retrofit Evaluation Program and Funding Schedule Overlap



Appendices to this report include more detailed findings and conclusions from five of the process evaluation activities detailed in Figure 1 and listed below:

» Logic models

» Data-mining results memo

» Tracking system review memo

» Benchmarking and Best Practices report

» Customer feedback memo

The detailed findings and conclusions spelled out in those documents are not fully restated in this report. Instead, key findings and conclusions are extracted and integrated in a format designed to inform program-level recommendations. The documents in the Appendices provide significant additional detail.

The following sections are organized to present and integrate Navigant's findings for each program or group of programs. The specific research streams drawn upon will vary depending on the program, but will include a combination of the following seven as previously detailed:

» Custom program logic models

» Program database mining

» Program/C&I customer database mining

» Benchmarking and best practices research

» Program management and implementation staff in-depth interviews

» Trade ally in-depth interviews

» Customer surveys

3.2.1 Cross Cutting Findings

This section details findings that cut across all of PSE's gas and electric custom retrofit programs. The primary research activities that provided input to these findings include program benchmarking, tracking system review, data mining, trade ally in-depth interviews and customer surveys. The latter two activities provide input to the team's free ridership and spillover findings.

PSE's C&I Custom Grant program is designed to encourage existing C&I customers to use electric and natural gas efficiently by installing cost-effective energy efficient equipment and implementing energy efficient operations at their facilities. Through this program, PSE works with C&I customers to review energy consumption at the customer's facility and to assess cost-effective energy savings or fuel switching opportunities from equipment, building shell, industrial processes or O&M improvements. These services are provided on the customer's behalf and, where specified by the customer, are developed in conjunction with design engineers, contractors, and/or vendors.

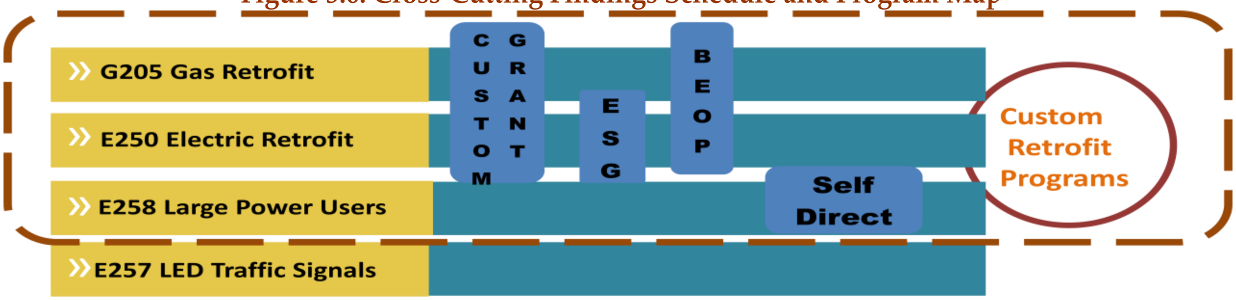
PSE's grant approval process has seven steps as show in Figure 3.5 below. PSE reviews third-party savings estimates and analyses and generates savings estimates. Where the project meets PSE cost-effectiveness funding criteria, PSE provides grants toward energy savings projects. PSE works with the customer to make sure financial decision-makers at the customer's facility are aware of the cost-savings opportunities. Upon notice of installation or implementation, PSE will verify the project as complete and operational, and issue payments to offset customer costs.

Figure 3.5. PSE Custom Grant Review Process

Findings presented here (Figure 3.6) span all of the custom retrofit programs and in some cases comprehend LED Traffic Signal program findings as well. All program data mining analyses include savings and participation from all four schedules. Some of the benchmarking findings cover just *custom retrofit program* comparisons, while others review *comparative C&I EE program portfolio* results. C&I

portfolio findings reflect combined program results from new construction, rebate, custom grant and others (like RCM). The first section, Section 4.2.1.1, covers only electric program results, while section 4.2.1.2 covers all gas results.

Figure 3.6. Cross-Cutting Findings Schedule and Program Map



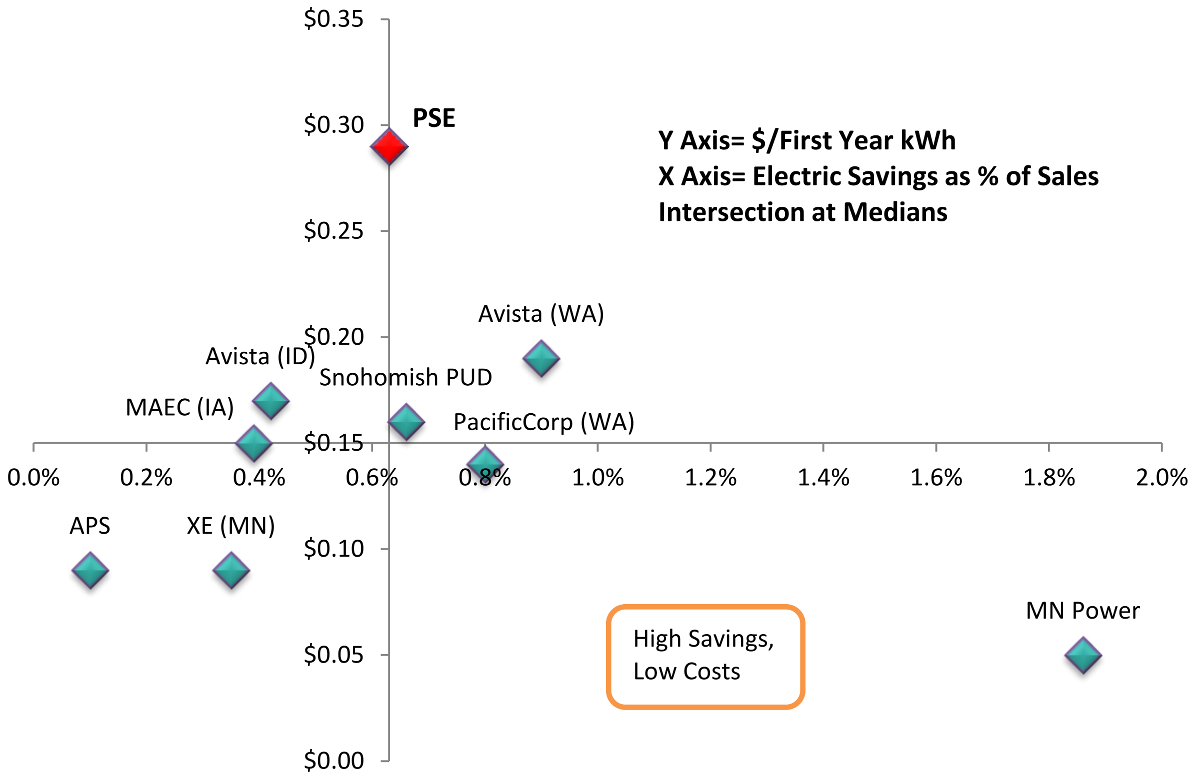
3.2.1.1 Overall Electric Custom Retrofit Program Performance

PSE clearly shows that, compared to the other benchmarked utilities, PSE is committed to supporting energy efficiency with its commercial and industrial customers. In 2009 PSE spent a higher percentage of its C&I revenue on DSM programs than all other benchmarked utilities except Seattle City Light.

In reviewing what PSE achieved with that spending, Navigant's benchmarking approach is to compare PSE's first year per kWh savings cost and first year savings volumes relative to total usage (to normalize for size) to comparable statistics for its peers. (This analysis does not incorporate any customer satisfaction ratings because they are not universally available.) Using Navigant's metrics, PSE's *electric custom retrofit programs* combined in 2009 were *relatively high cost* on a $/first year kWh saved and delivered *an average rate of savings relative to total C&I customer consumption*. Minnesota Power delivered the most savings at the lowest cost among the utilities benchmarked at the custom retrofit program level, though this comparison is somewhat apples to oranges since MN Power's "custom" program aggregates prescriptive, RCx, custom and Self-Direct components. Regionally, and more apples to apples, PacifiCorp Washington and Avista Washington delivered more savings as a percent of total consumption at lower first year cost than PSE. Seattle City Light program data are not available, while Snohomish's costs reflect only incentive.

Note that the two axes in Figure 3.7 cross at the point of average cost and average savings for the benchmarked utilities. Consequently, the lower right quadrant is the area where high savings/low cost utilities are mapped.

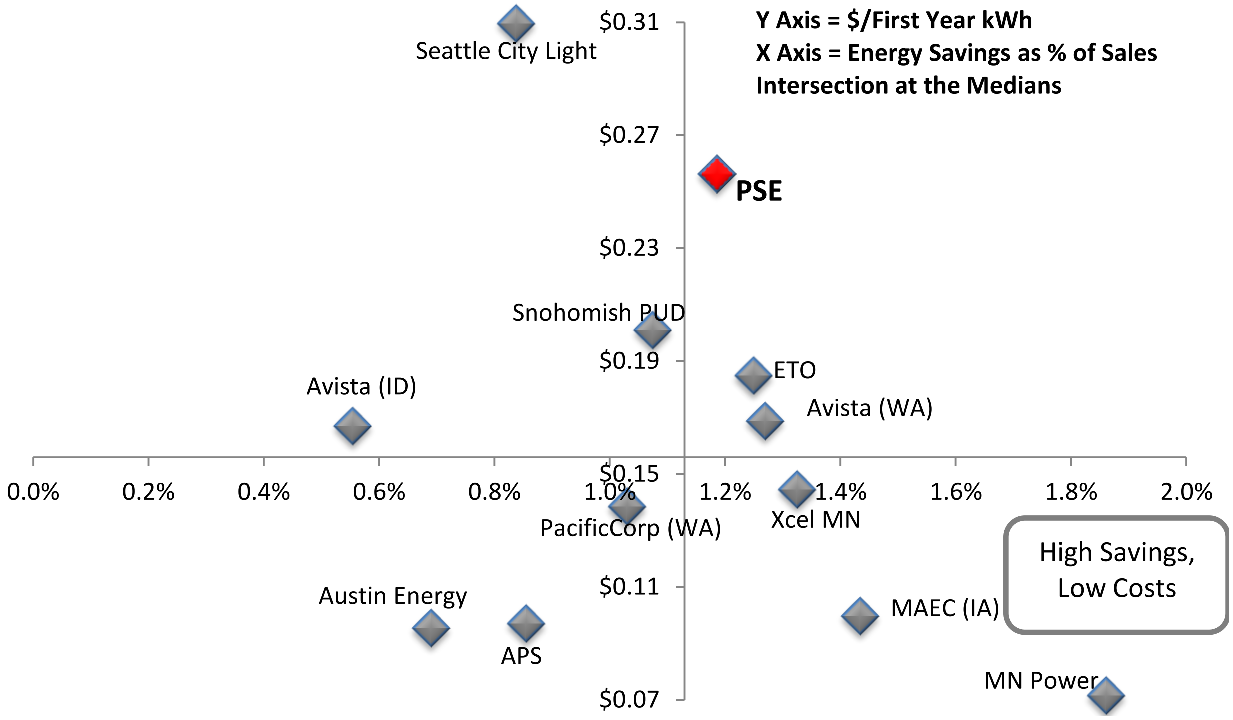
Figure 3.7. 2009 Electric Custom Retrofit Savings as % of Sales and Cost of First Year Savings, $/kWh



Note: Snohomish PUD's costs reflect only incentives. Seattle City Light detail not available.
Sources: See References at end of this report. Navigant analysis.

This pattern of relatively high cost per first year kWh and about median savings holds as well at the *overall C&I program portfolio level*. As with the custom program comparison, Minnesota Power has the highest savings at lowest cost, while both Avista Washington and PacifiCorp Washington – as well as Energy Trust of Oregon— appear to achieve higher savings at lower cost (closer to the lower right quadrant) than PSE. Again, Snohomish's data reflect only incentives. (Figure 3.8)

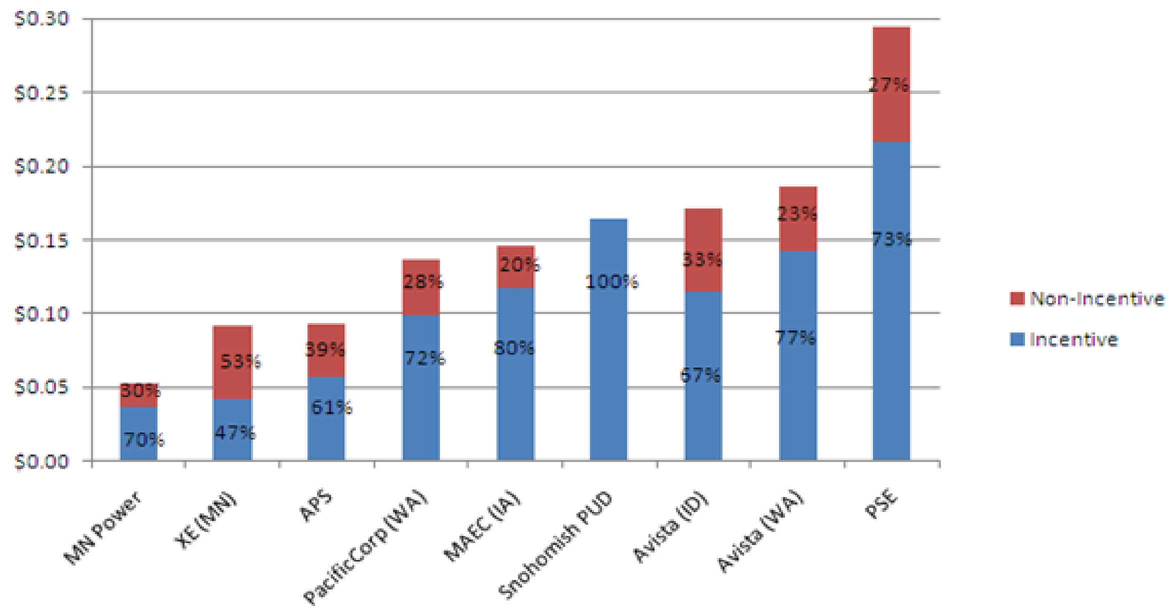
Figure 3.8. 2009 C&I Portfolio Energy Savings as % of Sales & Cost of First Year Energy Savings, $/kWh



Note: Snohomish PUD's costs reflect only incentives. Sources: See References.

PSE's per first year kWh spending is dominated by incentive costs, which are higher than all other benchmarked utilities total cost per first year kWh saved. (It should be noted that this data is not available for Seattle City Light, while Snohomish's costs only reflect incentives.) PSE's proportionate spending on administrative costs is among the lowest per first year kWh saved. (Figure 3.9).

Figure 3.9. Custom Retrofit Program Spending per First Year kWh Saved



Note: Snohomish PUD's costs reflect only incentives. Seattle City Light detail not available.
Sources: See References at end of this report.

3.2.1.2 Overall Custom Retrofit Program Electric Customer Segment Penetration

The previous sub-section's benchmarking analysis provides a view of comparative performance *across* utilities. Navigant's mining of program and customer data provides a view *within PSE and across PSE's customers by size and business type.* Specifically, Navigant used PSE's data to assess the relative rates of participation and savings as a percent of *all segment* customers and all segment kWh sold. These analyses are conducted at the **premise** level because of the complexities of defining customers. Customers and premises are used interchangeably to refer to premises.

Table 3-2 below details the custom retrofit program participants *by their rate schedule* and *compares the percentage of participants by schedule to PSE's C&I customer base as a whole.* PSE's electric custom retrofit program **participation** as a percent of total PSE C&I customers totaled about 1% of premises during 2009 and 2010. As would be expected with a custom grant program, smaller customers participated at a lower rate relative to total customer premises of comparable size. (Table 3-2) PSE's electric customer participation ranged from 0.3% of customers with demand less than 50 kW to 29% on average for customers with over 3 MW load and those on high voltage general service. Retail wheeling customers participated at a relatively low 6% rate over the two years.

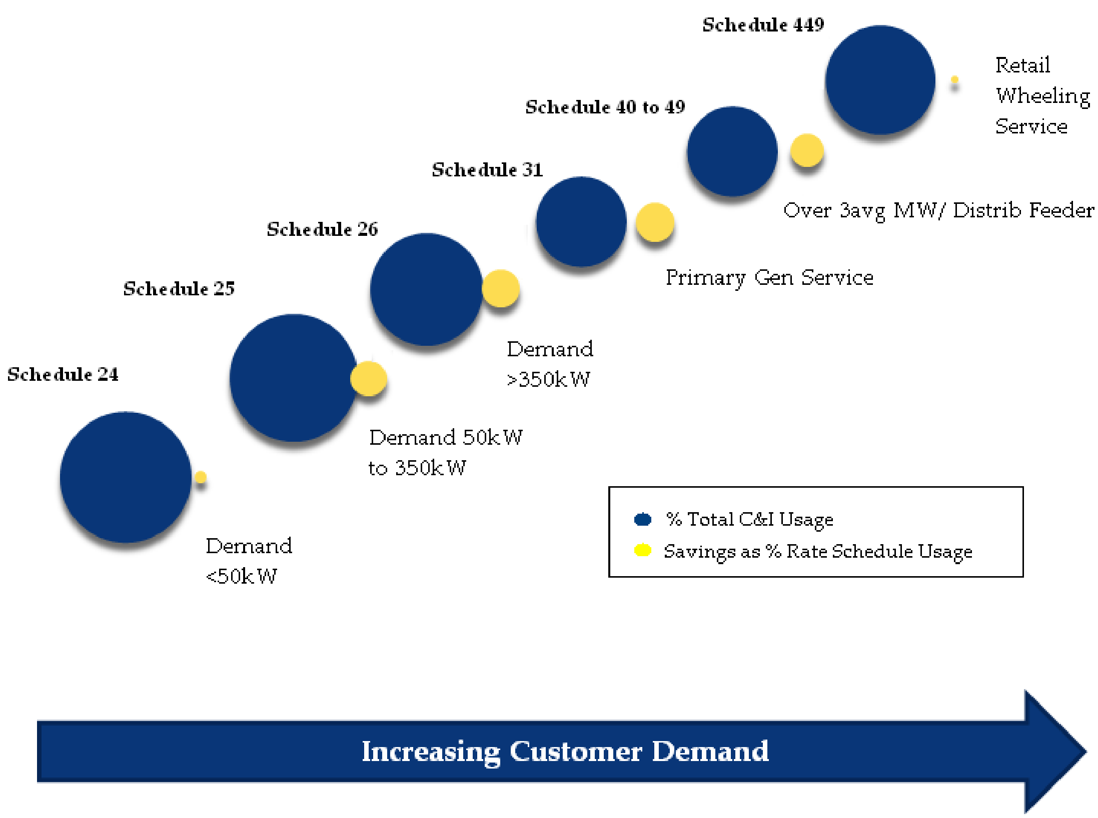
Table 3-2. C&I Electric Participation by Rate Schedule/Demand Tier (Premise level)

Rate Schedule	Service Description	Participants (% Total)	Premises (% Total)	Participants % Premises
24	**Demand < 50 kW**	24%	93%	**0.3%**
25	**50 kW < Demand < 350 kW.**	49%	5%	**9%**
26	**Demand > 350 kW**	13%	0.6%	**22%**
31	**Primary general service**	5%	0.4%	**14%**
40 to 49	**40: over 3 average MW/distribution feeder** **49: High voltage general service**	7%	0.2%	**29%**
449	**Retail Wheeling Service**	0.1%	0.01%	**6%**
Other*		1%	-*	**-**
Total		100%	100%	**1.0%**

Source: PSE program tracking system and PSE staff (Mei Cass) input; n= 1,356 participants and 131,457 customers. * Excluded from the analysis.

Electric program savings for the two years totaled 1.2% of 2010 consumption overall, or an average of 0.6% annually. (Figure 3.10) Segment specific savings levels for the custom retrofit program ranged from limited (0.1%) for retail wheeling customers to most significant (2%) for primary general service customers and customers with average monthly peak demand greater than 350 kW.

Figure 3.10. C&I Electric Savings by Rate Schedule Relative to Consumption



Source: PSE program tracking system and PSE staff ((Mei Cass) input.

Navigant then analyzed separately *large and small customer participation by business type*. As shown in Figure 3.11, PSE's custom retrofit programs have achieved overall large electric customer/premise penetration of 22% during 2009 and 2010 combined, and over 20% penetration of four customer types: retail trade (32%), information (27%), real estate/rental/leasing (23%) and other services (except public admin) (23%). As shown in Table 3-3, of PSE's large electric customers that account for more than 10% of the total large premise count, only two have below 20% participation over the two years: manufacturing (14%) and educational services (17%). While the former had been identified by PSE staff as a potential opportunity, educational services is rather a surprise given the high level of customer spending in that sector due to the availability of federal stimulus funds. This likely reflects the premise level analysis; whereas the customer may have participated, not all premises were retrofitted.

Table 3-3. Large C&I Electric Customer/Premise Participation by Type

Customer Type	Participants	Premises	Participants % Premises
	% Total		
Accommodation and Food Services	1%	2%	**8%**
Agriculture, Forestry, Fishing and Hunting	1%	2%	**8%**
Arts, Entertainment, and Recreation	1%	2%	**14%**
Construction	1%	2%	**16%**
Educational Services	12%	17%	**16%**
Health Care and Social Assistance	2%	4%	**11%**
Information	9%	7%	**27%**
Manufacturing	11%	14%	**17%**
Other Services (except Public Admin)	2%	2%	**23%**
Public Administration	3%	5%	**11%**
Real Estate and Rental and Leasing	5%	5%	**23%**
Retail Trade	18%	12%	**32%**
Transportation and Warehousing	1%	3%	**8%**
Utilities	1%	3%	**9%**
Wholesale Trade	2%	3%	**20%**
Others	14%	15%	**19%**
No match with customer database	13%	-	**-**
Total	97%	97%	**22%**

Navigant also assessed PSE's smaller customer (Schedule 24 and 25) participation in the custom retrofit program, though clearly the program is unlikely to target many of these customers other than national chains. Not unexpectedly, penetration of smaller customers/premises is a much lower 0.8% over the two year period, ranging from 0.1% to 3% (Table 3-4). PSE achieved 3% small customer participation in two segments, accommodation and food services and retail trade, both segments with significant national chain presence.

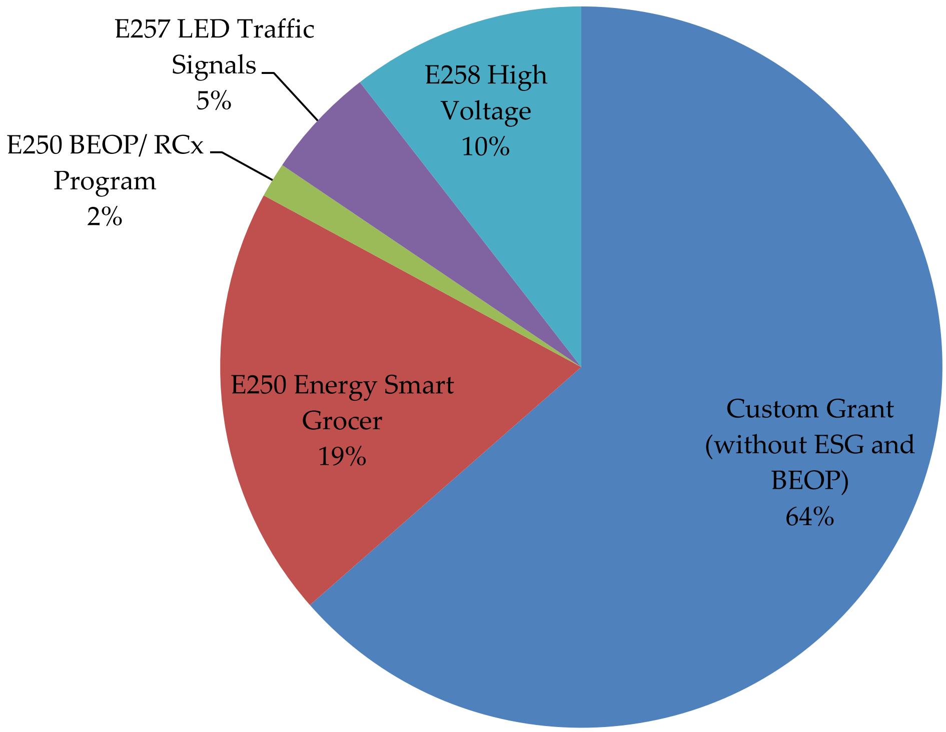
Table 3-4. Small C&I Electric Customer/Premise Participation by Type

Customer Type	Participants	Premises	Participants % Premises
	% Total		
Accommodation and Food Services	12%	4%	**3%**
Admin, Support and Waste Mgmt	1%	2%	**0.3%**
Arts, Entertainment, and Recreation	2%	2%	**1%**
Construction	1%	4%	**0.2%**
Finance and Insurance	4%	2%	**2%**
Health Care and Social Assistance	2%	4%	**0.5%**
Information	1%	3%	**0.2%**
Manufacturing	7%	4%	**1%**
Other Services (except Public Admin)	4%	12%	**0.3%**
Professional, Scientific, and Technical Services	1%	3%	**0.2%**
Public Administration	4%	4%	**1%**
Real Estate and Rental and Leasing	4%	12%	**0.3%**
Retail Trade	24%	7%	**3%**
Transportation and Warehousing	2%	2%	**1%**
Utilities	1%	4%	**0.1%**
Wholesale Trade	3%	2%	**1%**
Others	17%	27%	**1%**
No match with customer database	3%	-	**-**
Total	92%	97%	**0.8%**

Source: PSE program tracking systems and customer database. n= 995 small participants and 121,732 small customers.

The following discussion relates to analysis only of the program databases and does not include any references to C&I customers overall. Drilling down within *total custom retrofit program savings alone (the four schedules evaluated by Navigant)*, Schedule E250 accounts for 85% of total program kWh savings, with Schedule E258 accounting for an additional 10%. (Figure 3.11)

Figure 3.11. C&I Custom Retrofit Program kWh Savings: 2009 and 2010

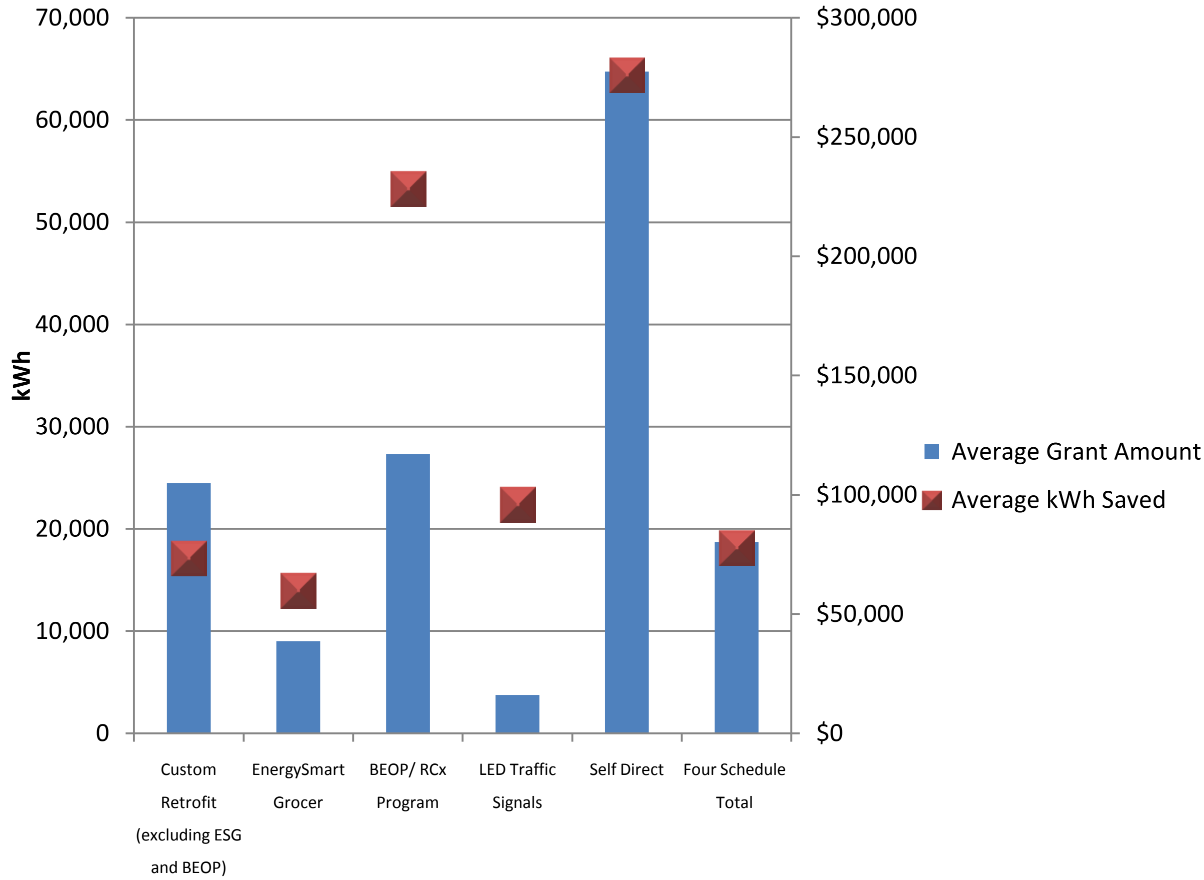


Total two-year savings for PSE DSM programs = 160.3 GWh

Source: CSY Master Database, May 18, 2011.

Schedule E258 Self Direct projects have both the highest average grant amount and the greatest average (first year) kWh saved per project, though BEOP projects are not that much smaller in terms of kWh saved. (Figure 3.12)

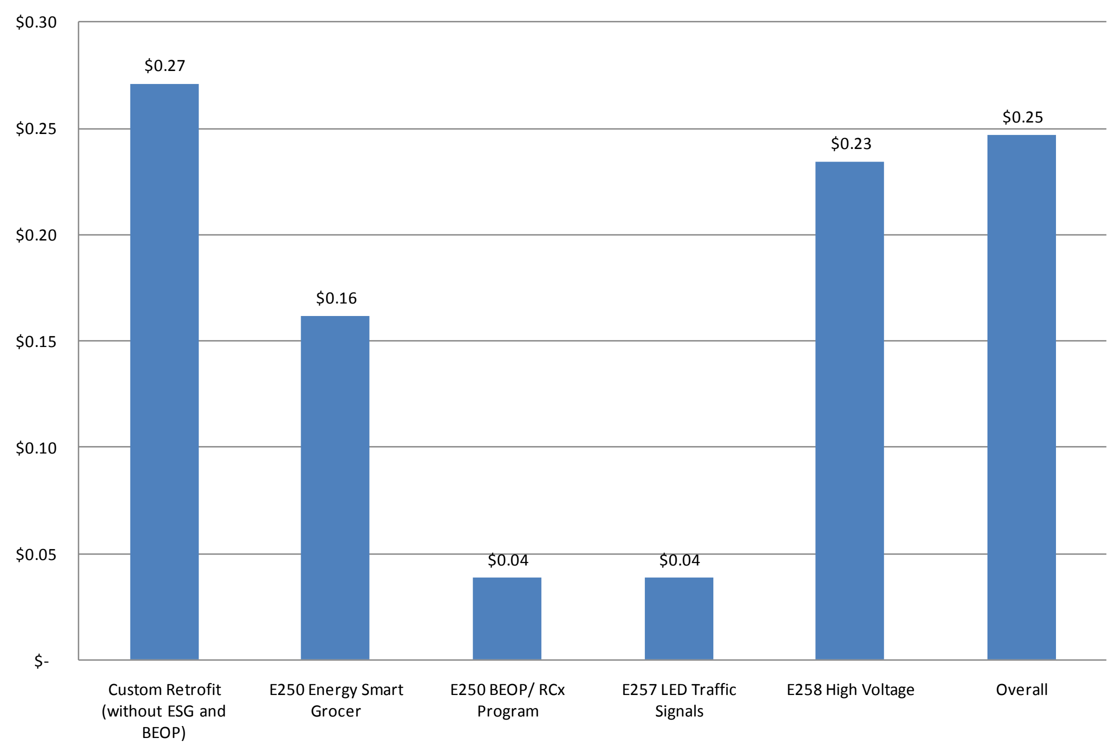
Figure 3.12. Custom Retrofit Program Average per Project Grant Amount and First Year KWh Saved



Source: CSY Master Database, May 18, 2011. Navigant analysis.

The average incentive cost per first year kWh saved in the programs evaluated was $0.25. LED Traffic Signal and BEOP incentives are the lowest cost per kWh. (Figure 3.13)

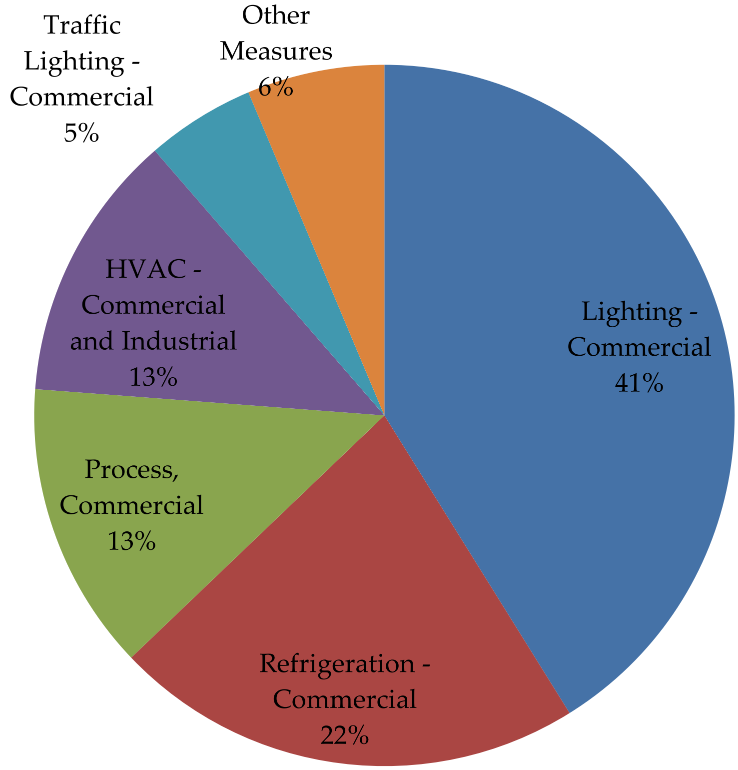
Figure 3.13. Custom Retrofit Program Average Incentive Cost per First Year kWh Saved



Source: CSY Master Database, May 18, 2011. Navigant analysis.

Approximately 80% of all measures incented by the custom retrofit programs are electric measures. Non-lighting measures accounted for 59% of total kWh savings during the two years, mostly refrigeration, followed by process and HVAC measures. (Figure 3.14)

Figure 3.14. Custom Retrofit Program kWh Savings by Measure

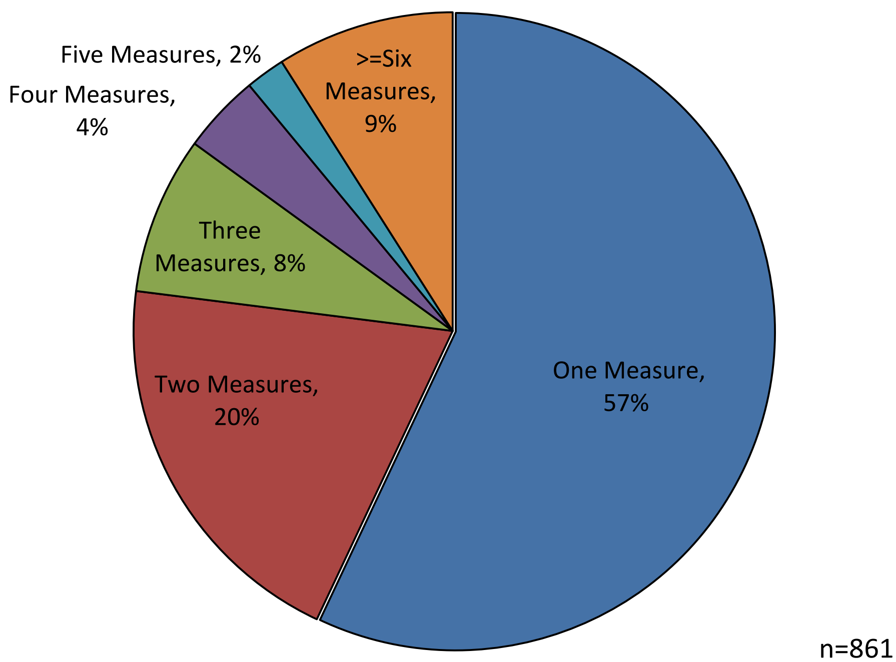


Total PSE Custom Retrofit Program Savings 2009-2010 = 160.3 GWh

Source: CSY Master Database, May 18, 2011.

For all the programs evaluated, 57% of participants implemented only one measure in the two years analyzed. At the other end of the spectrum, 9% implemented six or more measures during that period (Figure 3.15). It is highly likely that the current weak economic environment has resulted in more single-measure projects than would occur under more typical economic conditions.

Figure 3.15. Custom Retrofit Program Measure Frequency Distribution



Source: CSY Master Database, May 18, 2011. Navigant analysis.

Grocery stores, manufacturing and offices were the largest contributors to custom retrofit program savings, together accounting for 56% over the two year period. (Table 3-5) The least active sectors as measured by percent of total savings were restaurants, office/manufacturing and hospitals.

Table 3-5. Custom Retrofit Programs Participant Business Types: 2009-2010

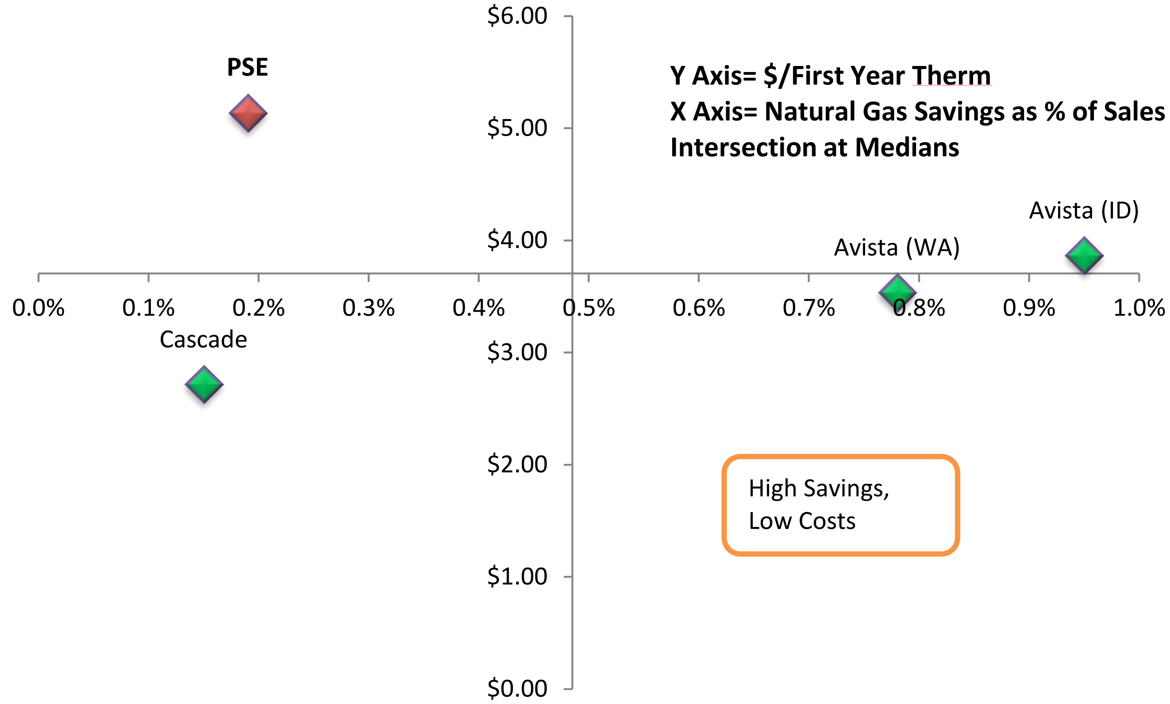
Business Type	Saved	Percentage of Total Savings
Grocery Store	38.8	24%
Industrial/Manufacturing	32.2	20%
Other	24.9	16%
Office	19.3	12%
Warehouse	11.7	7%
School	8.7	5%
Public Facility	8.2	5%
Retail	7.3	5%
Restaurant	3.5	2%
Office and Manufacturing	2.9	2%
Hospital	2.6	2%
Total	**160.3**	**100%**

PSE's top 25 (of over 500) electric trade allies accounted for 59% of electricity savings during the two years, with no trade ally implementing projects that accounted for more than 7% of savings. The three most active include two energy service companies, McKinstry (6.3% of savings) and MacDonald-Miller (3.2% of savings) and one lighting contractor, EWCO (5.7%). At the measure level, Real Win Win installed the greatest number of measures (11.7% of the total), followed by McKinstry with 6.7%.

3.2.1.3 Overall Gas Custom Retrofit Program Performance

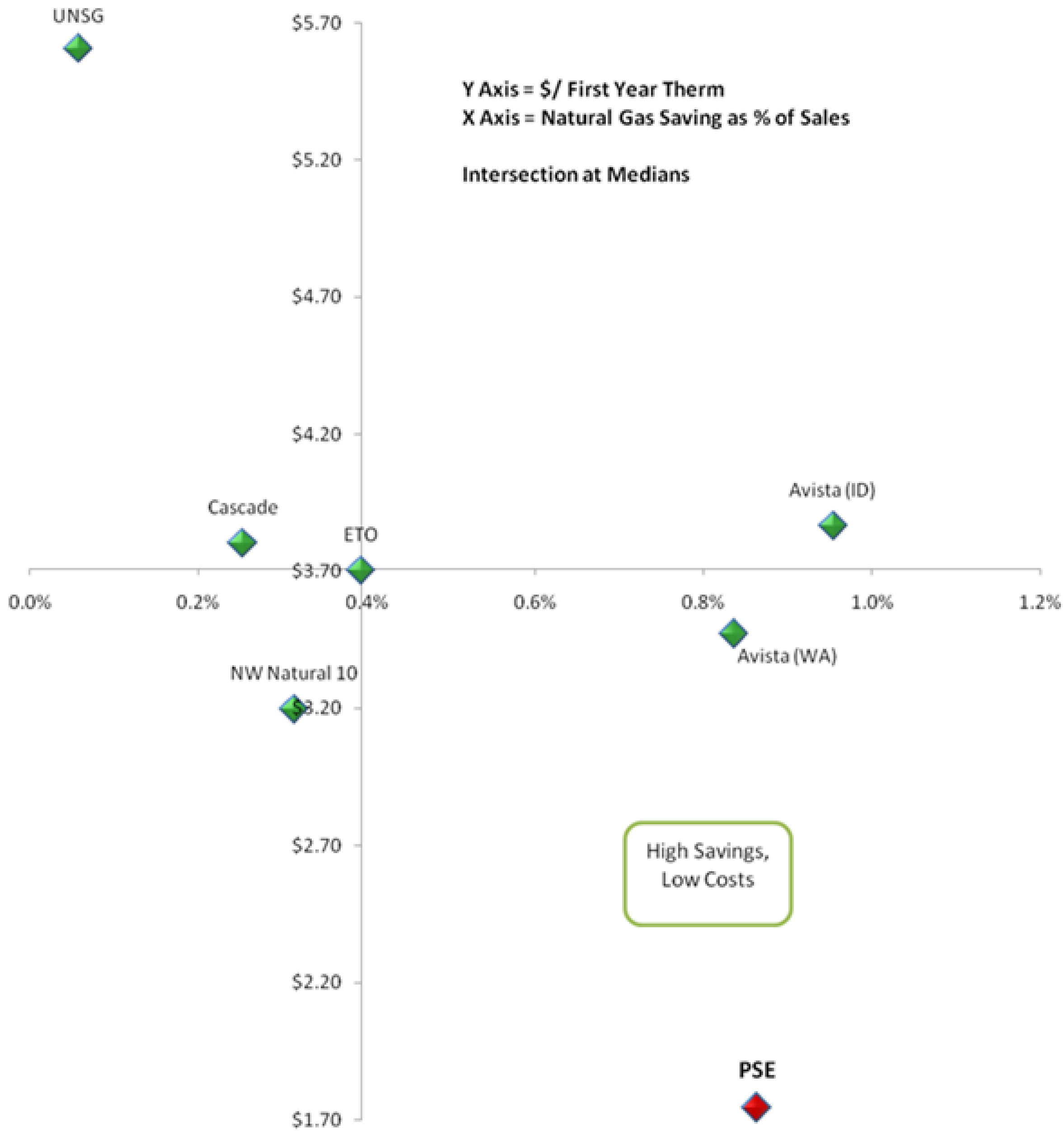
Benchmarking of PSE's custom retrofit program gas measures is more challenging than the electric side, as *limited custom-program specific data was available for the Northwestern region utilities benchmarked*. Only Cascade and Avista (Washington and Idaho) provided comparable cost and savings statistics for their custom retrofit programs. Among this panel on these metrics, Avista Washington achieved the highest savings at the lowest cost per first year Therm, while compared to Cascade PSE generated marginally higher savings at considerably higher cost per first year Therm. (Figure 3.16)

Figure 3.16. 2009 Gas Custom Grant Savings as % of Sales and Cost of First Year Savings, $/Therm



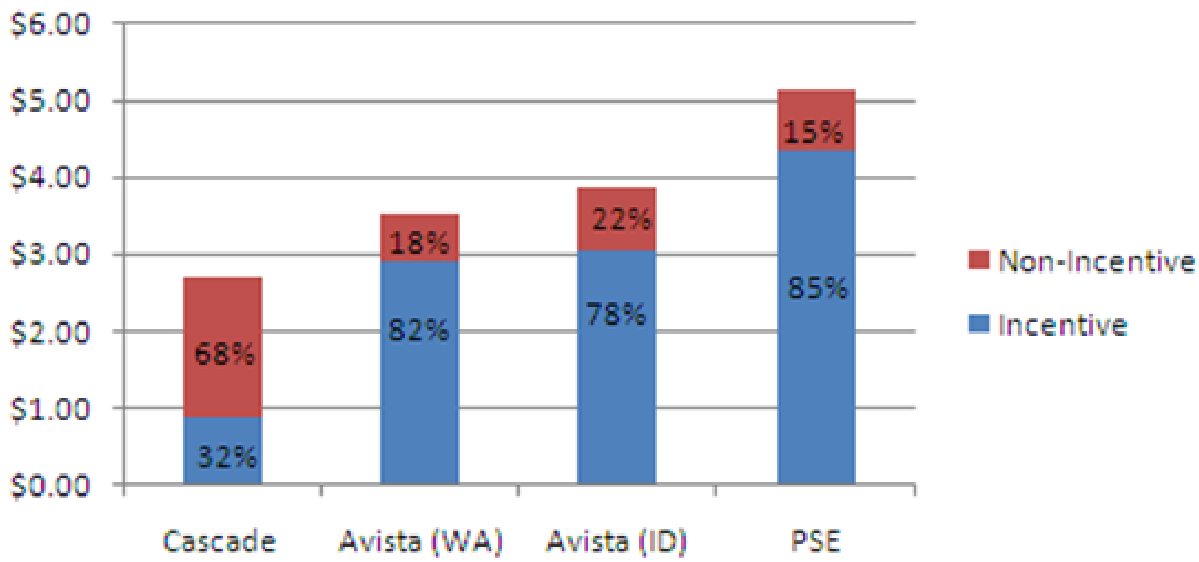
When program performance is benchmarked at *the* ***full C&I EE program portfolio level****, PSE's gas portfolio delivers amongst the best performance of the regional and other utilities.* Both Avista Washington and Avista Idaho spend more per Therm saved, while Avista Idaho saved more than PSE as a percent of Therms sold to C&I customers. (Figure 3.17)

Figure 3.17. 2009 C&I Gas Portfolio Savings as % of Sales and Cost of First Year Savings, $/Therm



Drilling down into *custom program* spending per first year Therm, PSE spends more overall, as well as for incentives, than the others reporting this level of detail. However, PSE's spending on non-incentive costs as a percent of the total first year cost is the lowest of the four. (Figure 3.18)

Figure 3.18. 2009 Gas Custom Programs' Incentive vs Non-Incentive Detail ($/Therm)



Turning to the data mining analysis for PSE's natural gas program participation, a similar pattern of lower participation by smaller customers/premises is evident, while overall participation in the Schedule G205 program is lower than for E250, E257 and E258. Overall participation is 0.6% of gas premises over the two year period. Only 0.4% of smaller customers participated during this period, while 7% of customers on interruptible gas service participated. (Table 3-6)

Table 3-6. C&I Gas Customer/Premise Participation by Rate Schedule

Rate Schedule	Service Description	Participants	Premises	Participants % Premises
		% Total		
31	**General Service**	63%	96%	**0.4%**
41	**Large Volume High Load factor**	19%	4%	**3%**
85 to 87	**Interruptible Gas Service**	10%	0.8%	**7%**
Other*		7%	-*	**-**
Total		100%	100%	**0.6%**

Source: PSE program tracking system and PSE staff (Mei Cass) input. n= 329 gas participants and 56,918 customers.
*Excluded from the analysis.

Gas program savings over the two years as a percent of total 2010 C&I consumption was 0.3%, while savings for the various consumption tiers ranged from 0.1% to 0.3%. (Table 3-7).

Table 3-7. C&I Gas Savings by Rate Schedule (size)

Rate Schedule	Service Description	Program Savings	Usage	Savings % Usage
		% Total		
31	**General Service**	31%	38%	**0.2%**
41	**Large Volume High Load factor**	8%	16%	**0.1%**
85 to 87	**Interruptible Gas Service**	59%	45%	**0.3%**
Other*		2%	-*	**-**
Total		100%	100%	**0.3%**

Source: PSE program tracking system and PSE staff (Mei Cass) input. * Excluded from the analysis.

Small gas customer participation was the lowest of all four segments reviewed, at 0.4%. Participation reached 1% in Educational Services alone. Manufacturing, (0.6%) Transportation and Warehousing (0.6%), Public Administration (0.5%) and Wholesale Trade (0.5%) all had above average participation. Two of the larger sectors in terms of total PSE premises, retail trade and other services (except public administration), achieved about average participation, at 0.4% each. (Table 3-8) Comparable data was not available to evaluate large gas customer participation.

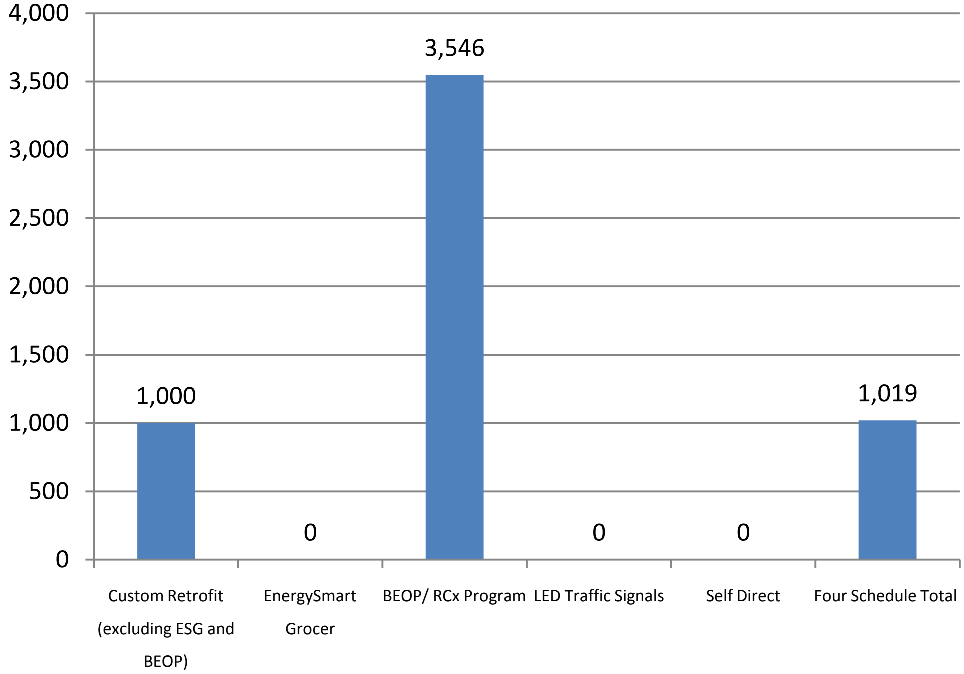
Table 3-8. Small C&I Gas Customer/Premise Participation by Type

Customer Type	Participants %	Premises %	Participants /Premises
Accommodation and Food Services	7%	8%	**0.3%**
Administrative and Waste Management	-	2%	**-**
Arts, Entertainment, and Recreation	2%	2%	**0.4%**
Construction	1%	3%	**0.1%**
Educational Services	6%	2%	**1.0%**
Finance and Insurance	1%	2%	**0.2%**
Health Care and Social Assistance	3%	4%	**0.3%**
Manufacturing	14%	7%	**0.6%**
Other Services (except Public Administration)	11%	11%	**0.4%**
Professional, Scientific, and Tech Services	1%	3%	**0.01%**
Public Administration	1%	2%	**0.5%**
Real Estate and Rental and Leasing	5%	9%	**0.2%**
Retail Trade	14%	11%	**0.4%**
Transportation and Warehousing	2%	2%	**0.6%**
Wholesale Trade	5%	4%	**0.5%**
Others	14%	27%	**0.2%**
No match	9%	-	**-**
Total	97%	99%	**0.4%**

Source: PSE program tracking systems and customer database. n= 207 small gas participants and 54,463 small gas customers.

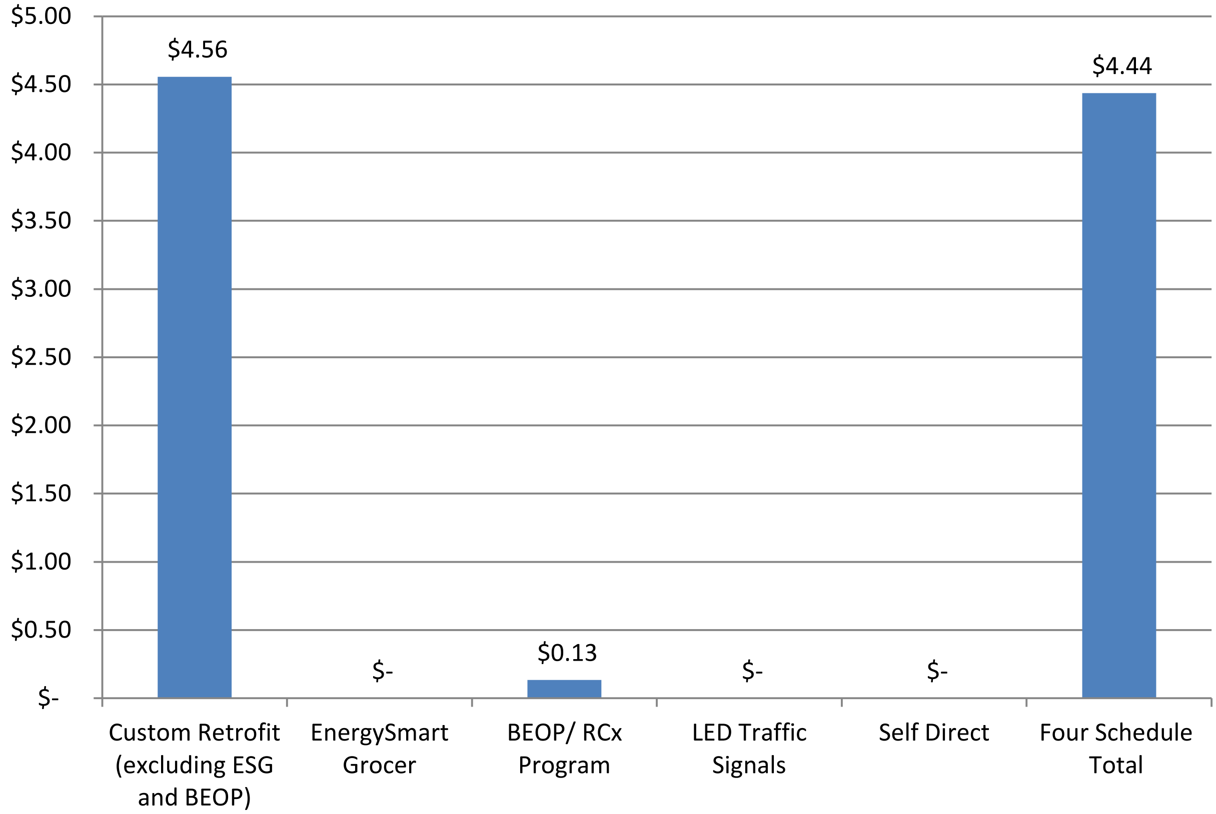
Average Therms saved for the custom retrofit projects implemented in 2009 to 2010 totaled 1,019 per project, as shown in Figure 3.19. Custom grant projects averaged 1,000 per project, while BEOP projects averaged a higher 3,546.

Figure 3.19. Average Custom Retrofit Project First Year Therms Savings



The average incentive cost per first year Therm saved in the programs evaluated was $4.44. The majority of Therm savings (97%) came from the Custom Retrofit program, which had an average cost of $4.56 per Therm. Cost per Therm was significantly lower for BEOP at $0.13 per Therm. (Figure 3.20)

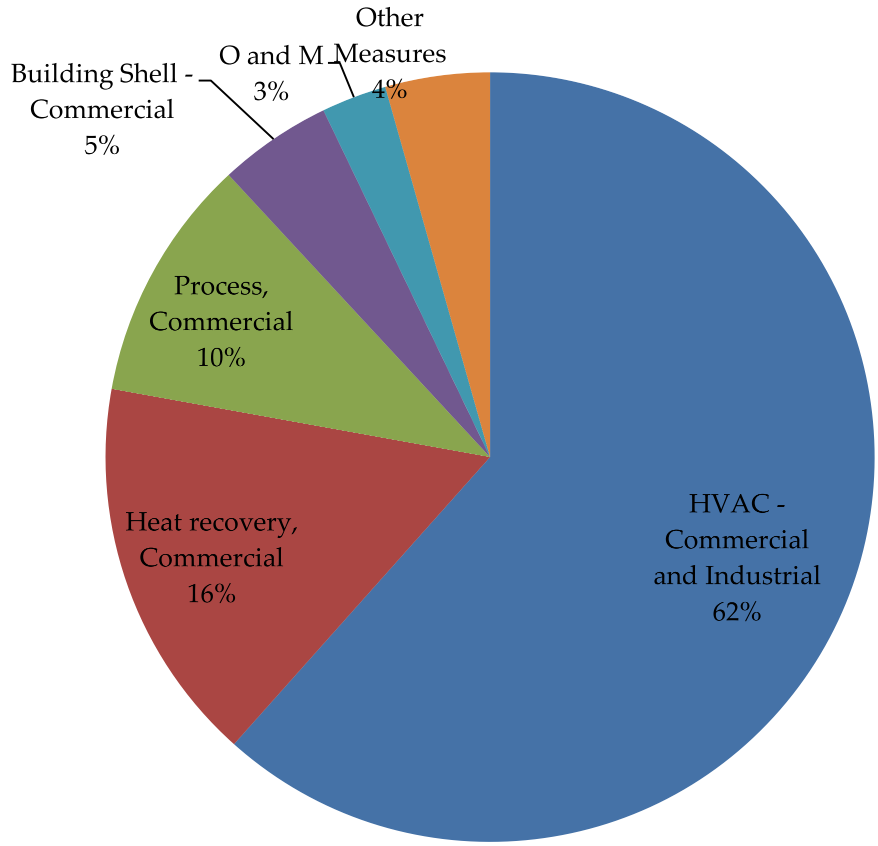
Figure 3.20. Custom Retrofit Program Average Incentive Cost per First Year Therms Saved



Source: CSY Master DAtabase, May 18, 2011. Navigant Analysis

Approximately 20% of all measures incented by the custom retrofit programs are gas measures. Gas measures are dominated by HVAC measures, which account for 62% of all gas savings (Figure 3.21). Commercial process and heat recovery measures account for a combined 26%, with shell measures contributing an additional 5%.

Figure 3.21. Custom Retrofit Program Therm Savings by Measure



Total two-year savings for PSE DSM programs = 1.4 million Therms

Source: CSY Master Database, May 18, 2011.

Gas savings were more dispersed among a variety of business types than electric savings were, with "other" accounting for 29% of the total as shown in Table 3-9. Manufacturing was a major Therm savings contributor as with kWh, accounting for 18% of the total over 2009 and 2010. Schools were another notable source of Therm savings, with 13% of the total.

Table 3-9. Gas Participant Business Types: 2009-2010

Business Type	Therms Saved	Percentage of Total Gas Savings
Other	408,659	29%
Industrial/Manufacturing	262,929	18%
School	185,810	13%
Public Facility	117,990	8%
Swimming Pool	87,039	6%
Restaurant	65,184	5%
Hospital	64,879	5%
Apartments	51,682	4%
Health, Non-Hospital	40,933	3%
Warehouse	33,654	2%
Hotel	27,049	2%
Office	25,286	2%
Church	24,290	2%
Data Center	18,813	1%
Athletic Club	10,275	1%
Total	**1,424,472**	**100%**

Source: CSY Master Database, May 18, 2011.

Activity among PSE's **gas trade allies** is more concentrated in fewer trade allies than in electric. PSE's top 10 gas trade allies accounted for 75% of all Therm savings during the two years.

3.2.1.4 Tracking System

PSE's custom retrofit program tracking system and customer data have some significant strengths as well as potential for enhanced system effectiveness. PSE's system's most notable strengths are the collection of data that enable the analysis of participating and non-participating customers – rate schedules in program databases and NAICS codes for most customer records. In addition, the simple mapping of detailed measures to types (e.g., lighting) enables a quick analysis of types of measures being undertaken while retaining the underlying detail. PSE's tracking system also has some weaknesses, many which relate primarily to program delivery metrics, features that have become more important as the PSE C&I Custom Grant team's workload has increased.

Well designed tracking systems have features that enable the following program management capabilities:

» Measurement of program efficiency and performance against time-based targets

- Tracking of customer communications to enable effective on-going interaction and maintain easily accessible records of such
- Tracking of trigger dates to enable follow up with customers to increase participation (e.g., signal need to contact customer as a deadline approaches)
- Electronic file maintenance for future ease of access
- Engineering resource management

Various PSE staff informed Navigant that a number of these needs have been identified and are targeted for implementation in a new system.

An additional potential tracking system weakness is the lack of a unique record (primary key) identified for each record in the program database. Records are measures which are now linked together by the project number, but each record and project number combination does not have its own distinct identifier. Such an identifier may not have been critical in the past, but when PSE decides to link the program tracking database to a customer relationship management system such identifiers will be necessary to be able to access individual records.

Overall, PSE's tracking system captures considerable amounts of useful data for a process evaluation. As detailed in Navigant's May 22, 2011 draft memo, PSE should consider more consistently collecting trade ally data as its goals become more challenging and it needs to work still more closely with its trade allies. Navigant also identified in its May memo attached as Appendix J other less significant opportunities to enhance its data that PSE may wish to address.

3.2.1.5 Free-ridership and Spillover

Free-ridership (FR) and spillover (SO) were assessed for PSE's custom retrofit programs by two primary means: trade ally in-depth interviews and participant and non-participant surveys. Findings are summarized in this section.

Trade Ally FR and SO Feedback

Trade allies were asked to rate the importance of incentives in their customers' decisions to invest in energy efficiency measures on a scale of one to ten, with ten being extremely important. Many trade allies in the EnergySmart Grocer and C&I Retrofit programs indicated that incentives were often a "make or break" factor in their sales of efficient equipment. Responses from BEOP trade allies suggested incentives were somewhat less important to their participants than to those of the other programs. Table 3-10.

Table 3-10. Importance of Incentive for Customers, Rated from 1 to 10 by Trade Allies

Program	Average Importance	Standard Deviation	Sample Size
Building Energy Optimization	8.33	2.06	6
EnergySmart Grocer	9.50	0.87	5
C&I Retrofit	9.08	1.61	12

These results *could be read to suggest* that free-ridership is fairly low, especially for the EnergySmart Grocer program. Free-ridership in the BEOP program may be higher based on the trade allies' assessment of the lower average importance of incentives and higher standard deviation. These conclusions are quite soft, however, given the relatively small sample of trade allies queried as well as the trade allies' natural interest in keeping the programs operating.

Trade allies stated that the majority of eligible projects they are involved with go through PSE to receive the related incentive. At the same time, some trade allies commented that they had done a few projects that would have been eligible for incentives but they did not apply for them, creating some spillover in the market:

» Commissioning agents stated that a few projects they were involved with would have been eligible but did not go through the program because the timing would not have worked out.

» For the EnergySmart Grocer Program, some eligible projects might not go through the program because of the short term timing of the project.

» For the Custom Grant Program, trade allies commented that it takes a long time to get custom grants approved or in limited cases there might be additional funding sources (federal government) so some projects that were eligible did not go through the program.

Navigant did not identify any other participant or non-participant spillover in the trade ally interviews that would be easily quantified. Typically this spillover is driven by training and changes in contractor practices that affect projects completed outside of utility programs. *PSE has clearly impacted the broader market for energy efficiency products and services,* as evidenced by trade ally comments that they have hired staff and expanded due to the program. Additionally, new contractors have entered the markets targeted by PSE's programs, thereby increasing market size and competition within them. Quantifying these market effects would require detailed studies of each market.

Participant and Non-Participant FR and SO Feedback

Free-ridership

The logic model used for Navigant's free-ridership analysis reflects four survey questions. The first three questions relate to the timing of the project, the level of equipment efficiency, and the quantity of measures the customer would have undertaken without the program. Customers' responses are translated into a free-rider value. Then, this value is adjusted through the attribution question, the level of program importance in the customer's decision. The analysis found a 27% free-rider rate for the PSE's Custom Grant program overall excluding Schedule 258.

Free-ridership by Schedule 258 customers, in contrast, is only minor, with most customers stating that projects would have been implemented more than a year later (or never)and in fewer quantity without the incentives. Almost all participants rated the financial incentive as somewhat important or very important for installing the measures.

Participant Spillover

Participant spillover was also calculated based on customer survey responses. Specifically, respondents were asked whether they had taken any other energy efficiency actions at the facility located where the program participating measure was installed (or any other facility owned by their corporation in PSE territory) that did NOT receive incentives from PSE. They were also asked what action was taken.

The analysis evaluated two types of spillover:

- *Inside Facility Spillover:* EE measures similar to program measures, and other EE actions (including behavioral changes), were installed by the customer in the *same* facility without receiving a program incentive.

- *Outside Facility Spillover*: Measures similar to program measures, and other EE actions (including behavioral changes), were installed by the customer in *another* facility (in PSE territory) owned by the participant without receiving an incentive.

Because the survey did not ask for spillover project savings details, the analysis assumed, for any spillover identified, an average spillover project savings comparable to that of the incented project average. According to the program database, the average project savings during 2009 and 2010 were 60,433 kWh and 5,248 Therms, specifically reflecting the average measure savings shown in Table 3-11. For spillover measures which were not in the database, a 5,000 kWh assumption was used. These measures included: gas range, de-watering device, timers for compressors, metering devices, occupancy sensors, turning off lights, and the like.

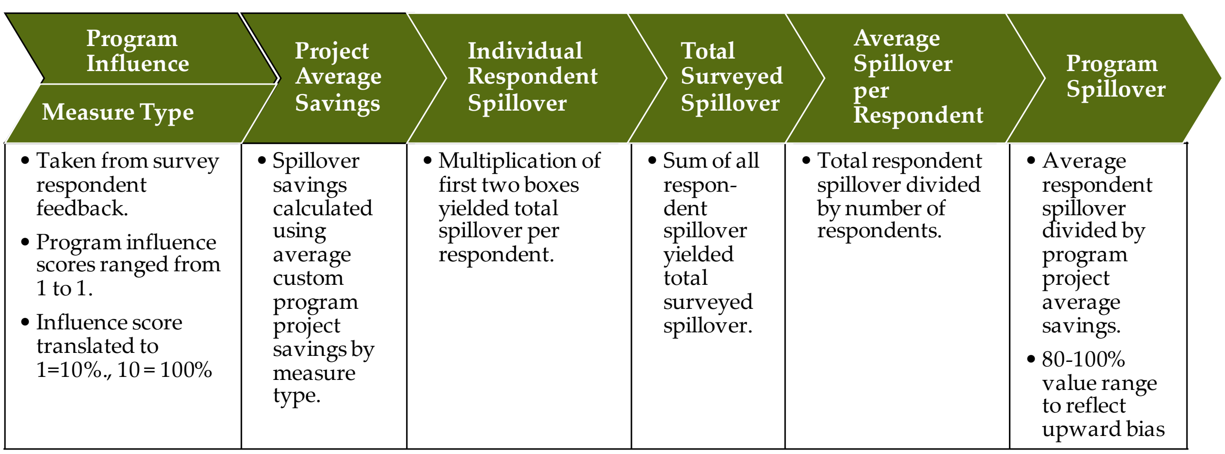
Table 3-11. Program Measure-Type Average Gross Savings Per Project

Program	Measure	kWh	Therms
ESG	Refrigeration	38,226	
C&I	Lighting Prescriptive*	20,571	
C&I	Lighting Commercial	71,455	
C&I	Motors	64,673	6,678
C&I	Refrigeration	75,015	
C&I	HVAC	100,157	4,957
C&I	Process	172,565	3,147
C&I	Water heating	3,040	1,748
C&I	Heat Recovery	27,670	33,050

Source: Master Database - 060911.xlsx.
* Due to uncertainty with whether the measure would qualify for the program, the more conservative Prescriptive Lighting savings value was used for all lighting measure spillover (participant as well as non-participant).

To identify spillover specific to each participant, the question inquiring about the influence of the program was translated into an influence percentage for each respondent. A score of no influence, 1, was translated into 10% and a score of high influence, 10, was translated into 100%. Then, the estimated savings per measure were multiplied by this influence percentage for both inside facility and outside facility spillover. All responses were added together to obtain total spillover for all survey respondents (44), and the average was calculated. This average was then divided by the average savings per project from the database to obtain the percentage of spillover that occurred due to the program. (Figure 3.22)

Figure 3.22. Spillover Development Methodology



For each spillover type a range is shown that represents 80% to 100% of the calculated value due to uncertainty involving savings arising from spillover projects relative to average savings for program projects. Results for Custom Grant program participants excluding Schedule E258 customers are presented in Table 3-12.

Table 3-12. Custom Grant Program (Excluding Schedule E258) Participant Spillover

N=44	Inside Facility Spillover		Outside Facility Spillover	
	kWh	*Therms*	*kWh*	*Therms*
Total for all respondents	504,000-630,000	16,000-20,000	288,000-360,000	10,000-13,000
Average for all respondents	11,500-14,500	370-460	6,500-8,000	230-2800
PARTICIPANT SPILLOVER	**19-24%**	**7-9%**	**11-14%**	**4-5%**

Source: Navigant analysis of surveys and in-depth responses for the Custom Grant Programs.
Note: Range is due to the uncertainty involving project savings and respondent overestimation of project activity.

The Process Evaluation Team found substantial spillover energy savings among Custom Grant participants (again excluding Schedule 258 participants.) An additional 30-38% kWh (gross savings) and 11-14% Therms are estimated to be saved due to program spillover. There is considerable uncertainty around these findings, however, because specific project details were not collected from respondents and these estimates were developed based on participant project savings.

In contrast, interviews with Schedule E258 Large Power User customers identified more limited spillover. While most sites reported installing efficiency measures without incentives, only a few attributed the Large Power Users Program with the motivation for those projects.

3.3 *Non-participant Spillover*

Non-participant spillover was also calculated using the participant spillover methodology. These savings reflect energy-efficient projects which customers undertook due to the program's influence, but for which they did not receive PSE incentives. Of primary importance in this analysis, respondents were asked how much their knowledge of the Custom Grant Business program influenced their decision to install high-efficiency equipment on their own. The answer to this question then drove the weighting of any potential savings from non-participant energy efficiency projects.

The Process Evaluation Team found substantial non-participant spillover savings occurring, presumably due in part to the program's maturity and long-term market presence. Even so, these levels appear to be quite significant for a Custom program, raising questions as to whether some of the non-participant spillover is due to other PSE programs. This is highly likely since many non-participants do not have the program familiarity to distinguish between PSE programs and a number of those surveyed were small businesses; however, this possibility was not explored further in this analysis.

Survey results indicate the average non-participant saves 30-37% and 18-23% of the participant project average kWh and Therm savings, respectively, influenced by PSE's C&I programs. This total would be multiplied by the number of non-participants, making the amount quite significant. Again, since specific project detail was not requested of respondents, it is highly likely that some if not most of the spillover relates to other PSE EE programs as well, not just the custom grant program. Since it is likely that these spillover projects include simpler and smaller projects covered under the Rebate program, Navigant adjusted the spillover savings range downward.

Total and average savings for respondents per measure as well as summary results are presented in Table 3-13. A range reflecting 80% to 100% of the estimated value is shown due to uncertainty involving savings arising from spillover projects relative to average savings for program projects. The foregoing percentages provide only an indication of potential non-participant turnover, and further research should be undertaken if it is necessary to determine specifically that component that relates to PSE's custom grant program distinct from others like the rebate and small business programs.

Table 3-13. Non-Participant Spillover: By Measure and Total

N=49	kWh				Therms		Total	
	Lighting	Cooling	Refrig-eration	Motors	Cooling	Motors	kWh	Therms
Total for all respondents	153,048-191,310	280,440-350,550	133,061-166,326	320,778-400,973	13,880-17,350	33,123-41,404	887,327-1,109,159	47,003-58,753
Average for all respondents	3,123-3,904	5,723-7,154	2,716-3,394	6,546-8,183	283-354	676-845	18,109-22,636	959-1,199
NON-PARTICIPANT SPILLOVER							30-37% kWh	18-23% Therms

Source: Navigant analysis of surveys and in-depth responses for the Custom Grant Programs.
Note: Range is due to the uncertainty involving respondent project activity estimates.

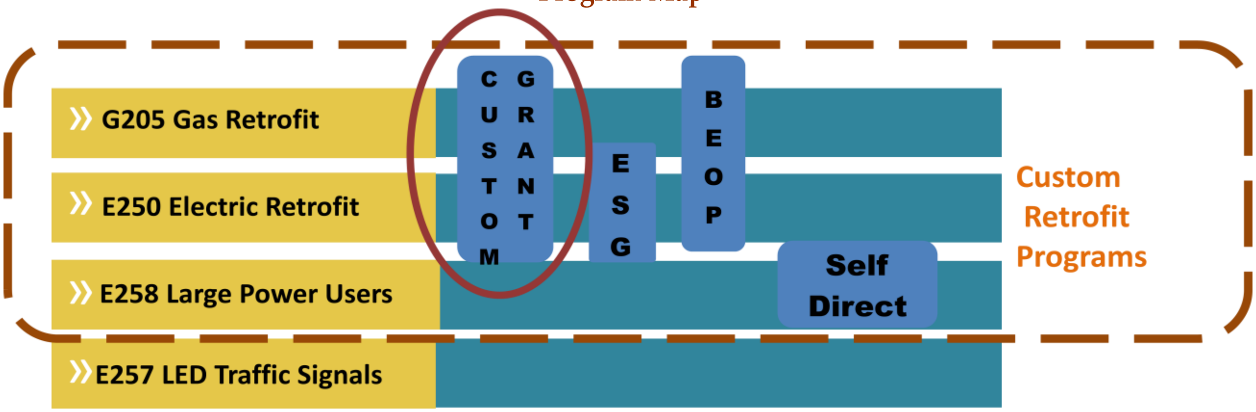
3.3.1 C&I Electric and Gas Custom Grant Program (excluding ESG and BEOP)

Navigant's process evaluation for the custom retrofit program (excluding ESG and BEOP) draws upon the following sources for these findings:

- Draft custom program logic model
- Program database mining
- Program management and implementation in-depth interviews
- Trade ally in-depth interviews
- Customer surveys

This section reviews results from the schedules indicated below, excluding ESG and BEOP (Figure 3.23).

Figure 3.23. Gas and Electric Custom Grant (excluding ESG and BEOP) Findings Schedule and Program Map



3.3.1.1 Overall Custom Grant Program (excluding ESG and BEOP) Performance

PSE's Custom Grant program (excluding ESG and BEOP) accounted for 64% of all kWh savings and 97% of all Therm savings for the schedules evaluated by Navigant. It accounts for 81% of all C&I participants in the programs evaluated and has the highest average incentive cost per first year kWh savings, at $0.27. Average incentive cost per first year Therm is $4.56. (Table 3-14).

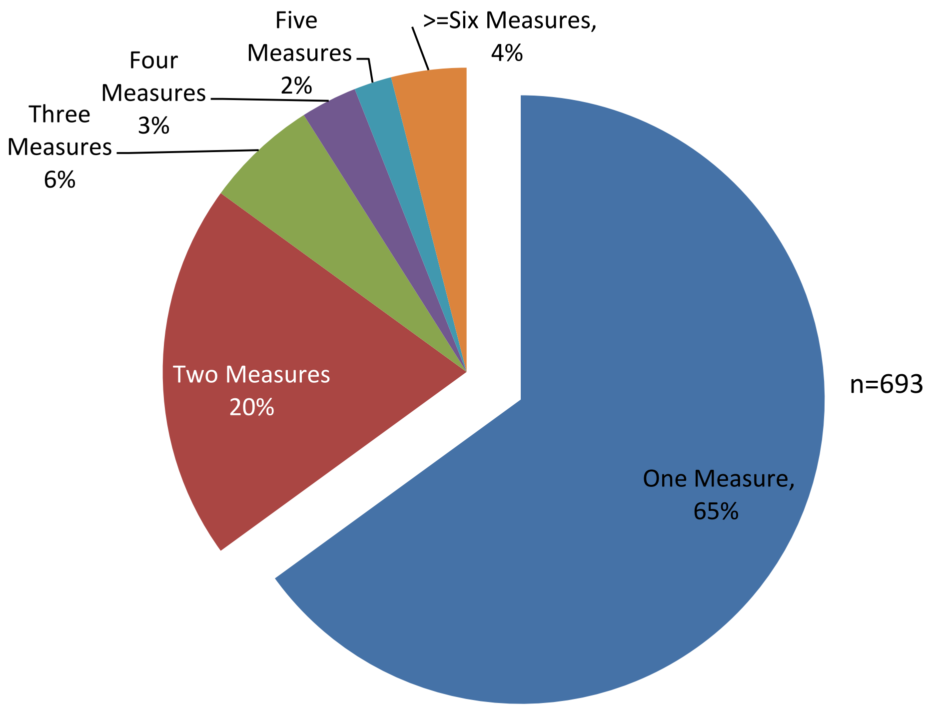
Table 3-14. Custom Grant (excluding ESG and BEOP) Program Overview

Program	Total					
	GWh Savings	% Electric Savings	Therm Savings (MDth)	% Gas Savings	# Participants	% Participants
Custom Retrofit (excluding ESG and BEOP)	101.85	64%	138.5	97%	693	81%

Program	Number of Projects	Average Per Project			Overall Average	
		Grant Amount	kWh Savings	Therm Savings	$/kWh	$/Therm
Custom Retrofit (excluding ESG and BEOP)	1,386	$24,479	73,486	1,000	$0.27	$4.56
Four Schedule Total	**2,060**	**$18,715**	**77,822**	**1,019**	**$0.25**	**$4.44**

During 2009 and 2010, in the Custom Grant program (excluding BEOP and ESG) the majority of participants implemented only one measure, with 85% implementing one or two measures in this period. (Figure 3.24) In contrast, 4% implemented six or more measures.

Figure 3.24. Custom Grant Program (excluding BEOP and ESG) Measure Frequency Distribution



Source: CSY Master Database, May 18, 2011. Navigant analysis.

3.3.1.2 Benchmarking Best Practices

Navigant's benchmarking of custom programs identified Avista Washington's custom program as a strong performer in the Northwest and Xcel Minnesota as a top performer nationwide. Avista Washington believes that its custom grant program has been successful at least in part because it directly involves Avista Account Executives (AEs) in program delivery and tracks AE performance against savings goals. AEs are given DSM targets that are part of their performance review. AEs generally target medium and large customers but will also cold call throughout a neighborhood to reach small customers. They are responsible for overseeing the projects and receive credit for both custom and prescriptive measure savings, but not behavioral, which has become an issue.

Avista Washington's program is run in-house, with audits provided by either an Avista engineer or, for industrial processes, an outside engineer. If savings are demonstrable and simple payback is greater than one year then they execute a contract and the customer completes the projects, the AE collects the receipts and post-verifies the install and the DSM group cuts the check. Avista reported they had been able to lower their incentives and add more in-house engineering and tech support. Seven full-time engineers now support Washington and Idaho custom programs.

Xcel MN is one of a number of utilities that are running segment-specific programs to achieve broader and deeper savings in targeted sectors. Its most successful program has been the Industrial Process program which uses the Envinta Assessment tool as a linchpin. (Avista does not have a Self-Direct program which typically targets many of the same customers.) The Industrial Process program was offered by Xcel MN beginning in 2002 and delivered 42 GWhs and 113 Dekatherms savings in 2010. The program is staffed by 1.5 program managers at Xcel.

Xcel's Industrial Process program is delivered by a third party which is responsible for setting up initial meetings, developing and delivering the assessment and managing the customer through the process over the multiple year effort. A relationship with a new participant starts with a three-hour meeting at the customer site with Finance, Facilities, Property Management and other related staff involved in energy policies, planning and decision making, followed by a facility walk-through in the afternoon. The consultant provides a three star rating at the end of the day based both on the information gathered that day and previously collected facility data and usage data. The third-party keeps working with customers who sign a memorandum of understanding MOU at each stage.

Xcel MN retains the administrative/regulatory role and processes the rebates - only because they could not find someone less expensive to whom to outsource the back office functions. Prescriptive and custom incentives in the Industrial Process program are rolled into a bundle enabling measure with longer paybacks to be subsidized by shorter payback projects. Bonus rebates are offered based on three year signed agreements – up to 20% incremental rebate in each year if target savings are achieved.

Xcel MN ran a similar program targeting the commercial real estate sector but it did not perform well during the three-year period of their program filing. Xcel MN believes it is because they chose the wrong provider, and their sister company, Xcel CO, is now running a similar program in its service territory. Navigant did not fully benchmark Xcel CO for this evaluation, but because PSE staff had identified the commercial real estate market as a potential under-performer, Navigant contacted Xcel CO to discuss their program.

In Xcel CO's commercial real estate program, the customer relationship begins with an ASHRAE Level 2 audit, good for two years, that identifies all savings opportunities and how they match up with Xcel CO's DSM programs. The utility limits studies to 50,000 square foot buildings or two smaller buildings. Xcel Colorado presently has one study provider authorized to provide the initial ASHRAE Level 2 audits, but they are looking to open the program to other providers. The program, which launched in 2010, did five studies in 2010 identifying 2 GWh in savings and six studies by May 2011. Implementation is underway for some customers.

Xcel CO pays the current study provider to market the program and has found that the third party is more effective than the Account Managers at bringing in customers. The utility offers a 30% bonus on top of the regular incentives (up to 75% of incremental cost) and covers half of the study cost ($2,500). In their experience, this program costs 15-20% more and is still cost effective. To generate a sense of urgency, they file for a three year program life. They have found that owner occupied buildings are the best target and that it is key is to get decision makers involved at the study presentation meeting, that is, the meeting where the ASHRAE level 2 audit findings are presented to the client. Overall, they believe this general approach is very effective and have filed to expand this program into the hospitality sector.

Navigant has noticed the deployment of sector-specific studies at other utilities that similarly appear to deliver superior savings. AEP Oklahoma has had success with a K to 12 and upper education targeted program run by a third party. A similar program targeting cities has gotten off to a slower start. Both of these programs include some benchmarking of participant facilities against DOE Portfolio Manager data.

National Grid is also taking two interesting tacks to increase participation of its smaller customers, though in National Grid's case the tactics are being applied in their direct install program. National Grid pays a $10 incentive to their call center reps who sign up a customer for an audit. They also involve their government affairs and community relations staff in scheduling a series of audits in a particular community over a narrow window of time. They have found that this approach enables them to obtain broader savings at lower cost.

3.3.1.3 Trade Ally Feedback: Program Efficiency

In this report, the in-depth trade ally interview findings for each of the C&I Retrofit programs are organized into three sections: Program Efficiency, Marketing and Outreach, and Enhancement Opportunities. Twelve trade allies (TAs) with varying levels of participation provided feedback on the Custom Grant program explicitly. These findings are presented in the following three subsections.

Overall, these twelve trade allies reported high satisfaction (1.5 out of 4, with a score of 1 being the highest possible) with the Custom Grant program, and most trade allies reported needing to add staff to meet program-driven growth. Trade allies nonetheless identified a number of program features that they felt discouraged program participation and that led them to prefer the faster and more predictable prescriptive program. *According to most trade allies contacted, the time required by the pre-qualification process, inspections, and payment process adds up and discourages many customers from participating*. In addition, many trade allies have difficulty predicting how large incentives will be unless they have had extensive experience with the program and relevant equipment, introducing an element of uncertainty that can be too high for many customers. Many potential projects do not have short enough payback periods to qualify. (It should be noted that any reference to payment process in this report is from the *participant's* perspective, that is, the time it took to get paid after implementing the measure. As this period includes verification, then from *PSE's* perspective, the issue is either in the length of time required until verification or from verification to payment.)

Table 3-15 details responses regarding specific program characteristics impacting efficiency.

Table 3-15. Trade Ally Feedback on C&I Retrofit Program Efficiency

C&I Retrofit: Program Efficiency	
Application Process	Many TAs commented that it can be hard to get some customers on board because it takes a while to pre-qualify and determine incentives. Many also find that program requirements are not always clear.
Effectiveness of Inspections	Most report that multiple inspections (specifically pre-and post) can take a long time, in part due to scheduling issues.
Paperwork Issues	Many TAs commented that PSE needs to keep them better updated on requirement changes and ensure that documentation requirements are clear.
Payment process	Most report at least some delays in grant payments, with some more understanding than others. For many, the lengthy time from installation to payment is a major program weakness.
Impact on contractor	Almost all report increased business. Many report additional hires; few changes in stocking practices.

3.3.1.4 Trade Ally Feedback: Marketing and Outreach

Many trade allies expressed a desire for increased outreach by PSE, both to them and their customers. Allies feel they have been given the task of bringing customers to the program, and resent lack of PSE presence in their projects. Trade allies recognize PSE as a powerful support in their efforts to market their products and PSE's program, and would like PSE to be more of a partner in the sales cycle. Increased technical training, direct communication with trade allies and customer education are strongly recommended.

Table 3-16 details responses on program training, marketing, and outreach.

Table 3-16. Trade Ally Feedback on C&I Retrofit Program Marketing and Outreach

C&I Retrofit: Marketing and Outreach Effectiveness	
Training availability and usefulness	About half reported receiving at least some training, which garnered mixed comments on how useful additional training would be. Some requested marketing training or a "plug and play" spreadsheet or other tool to make predicting savings easier.
Availability and quality of marketing materials	Those who had received marketing materials found them adequate (about half of interviewees). Some used their own material. Some found PSE's website helpful.
T`A Outreach Desired	Many TAs with moderate program activity would like to have more direct contact and a better relationship with PSE; more active TAs with such relationships are often more satisfied with and better informed about PSE's programs. Some TAs suggested that PSE should have a larger presence in projects and be more of a partner to TAs. Some also desired increased education of customers.

3.3.1.5 Trade Ally Feedback: Enhancement Opportunities

The most commonly identified need was to have a stronger relationship with PSE. Strengthening contractor relationships through increases in direct communication with trade allies about programs and both process and technical training can also help improve program transparency, another weak point in the program. Customer education and outreach is another area where PSE can develop the program further.

Table 3-17 highlights the main areas where PSE can improve the program.

Table 3-17. Enhancement Opportunities Based on Trade Ally Feedback

TA Feedback: C&I Retrofit Program Enhancement Opportunities	
Problem or Obstacle Identified	*Opportunity*
Many qualified customers cannot afford their share of measure costs	A few TAs suggested PSE explore ways to help customers finance measures.
Contractors often lose customers because of long process and prefer to use quicker prescriptive rebates when possible	Streamline entire application process, make incentives easier to predict through increased calculation process transparency and technical contractor training.
Many TAs do not feel supported by PSE and would like to have a better relationship with the utility	Enable direct communication between PSE and contractors, improve relationship through outreach and increased PSE presence for customer, keep TAs up to date on program opportunities with emails and periodic training workshops.
Some customers who are less educated about energy efficiency do not believe in the merits of the program	Increase customer education and outreach.
Contractors lose some customers because their needs do not fit into the program well	Increase TA education about program opportunities, consider expanding program to cover wider variety (unspecified) of equipment.
Some reported that training focuses more on process than technical education, and one indicated that PSE staff is not always knowledgeable about technology	Ensure that mechanisms behind incentives are made clear during training, and that PSE staff can provide answers to technical as well as process questions.

3.3.1.6 PSE Customer Feedback

Navigant surveyed a total of 103 [37 participant, 25 partial participant, and 41 non-participant] customers in the Custom Grant program (excluding ESG and BEOP customers), as shown in Table 3-18. In keeping with PSE's commercial and industrial customer base composition, the majority of participants surveyed self-identified as medium-sized businesses while the majority of partial and non-participants surveyed self-identified as small-sized businesses. Note that feedback from commercial real estate and light manufacturing customers is broken out separately in the survey findings where sensible, since these customer segments were identified by PSE program management as potentially under-served segments. However, since there were few commercial real estate and light manufacturing customers among the random survey sample, further research would need to be conducted specific to those sectors in order to confirm the findings in this analysis.

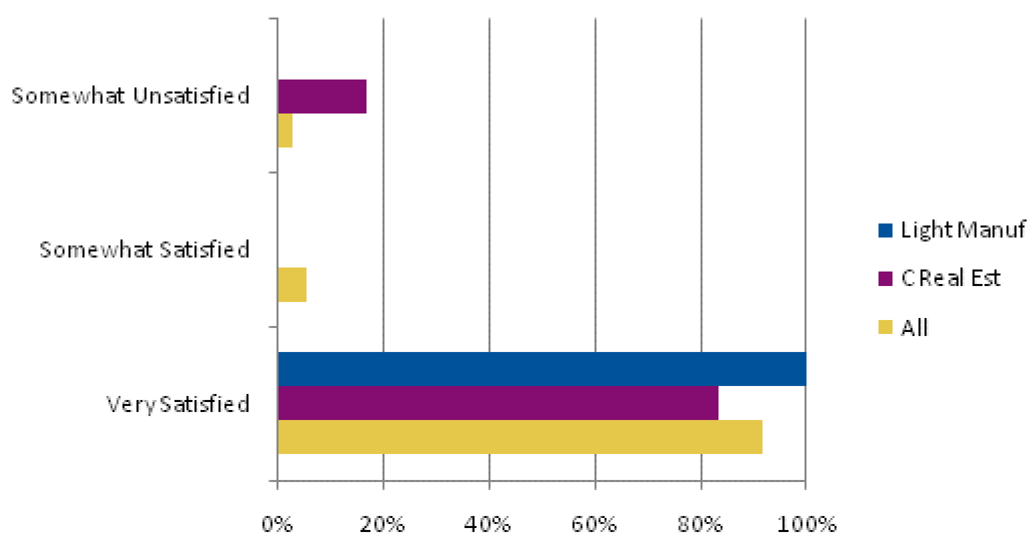
Table 3-18. Schedule E250/G205 Custom Grant (non-ESG and non-BEOP) Customer Survey Overview

Customer Type	# Surveys	% Small	% Medium	% Large	# Light Manufacturing	# Commercial Real Estate
Participant	37	24%	57%	16%	4	6
Partial Participant	25	56%	20%	24%	2	2
Non-Participant	41	49%	29%	5%	7	N/A

Participant Satisfaction

On a scale of one to four with one indicating "very satisfied," and four indicating "very unsatisfied," 92% of program participants reported being "very satisfied" with the program (Figure 3.25). All light manufacturing customers were very satisfied. In contrast, a lower 83% of commercial real estate customers were "very satisfied," while the balance (17%) were "somewhat unsatisfied." No participants reported that they would no longer take part in the program in the future.

Figure 3.25. Participant Satisfaction



Though most participants reported being very satisfied with the program, some issues were identified. About 11% of all customers noted that they experienced problems that included a process that took too long, inconsistent information, unclear requirements, and hard to access representatives. Two real estate participants commented that not all lighting was installed. None of the light manufacturing customers reported having problems while *four out of six* commercial real estate customers noted some variant of the problems noted above. These issues appear likely to be the source of the lower levels of commercial real estate customer satisfaction with the program.

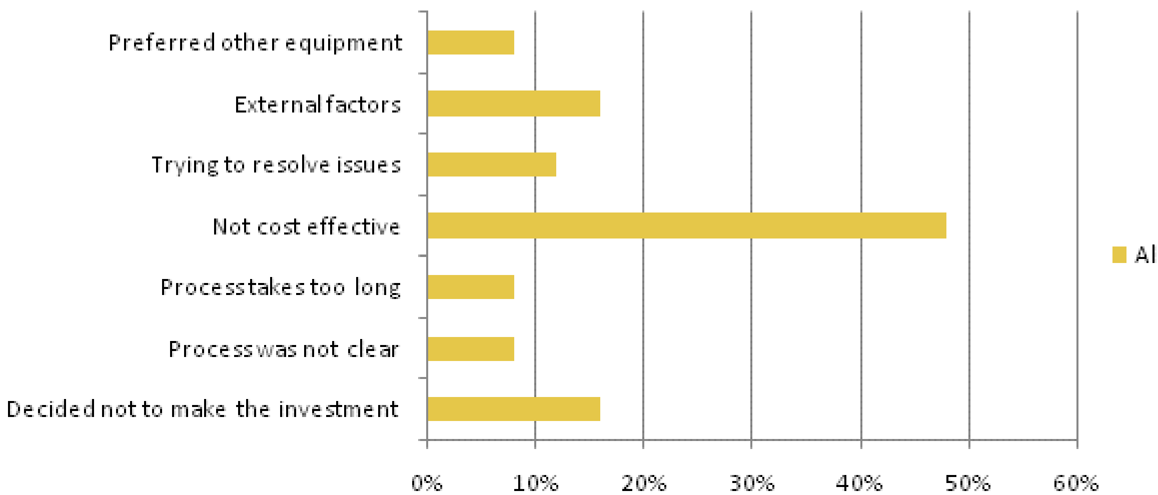
Program Improvement

Participant feedback indicates the **program delivery processes overall are functioning very well**. An estimated 97% of all participant customers agreed or strongly agreed that requesting program services from PSE was easy. Furthermore, another 97% of those customers reported that the application process was simple. The only area where some indicated improvement could be made was in allowing longer times to complete projects.

Marketing and outreach were areas with particular opportunity for improvement, which should be no surprise to PSE since relatively limited efforts have been expended in this area. Of the 41% of participants that gave suggestions to improve the program, one third suggested improving communication. Commercial real estate customers also mainly suggested improving communication and providing longer time periods to complete projects. Of the four light manufacturing customers interviewed, only one suggested an improvement, and that, again, was to improve communication.

Partial participant feedback suggests process-related issues were important for only 16% of those who were contacted. Two indicated that the program process took too long, and two found the process unclear, while 20% of partial participants moved forward with their projects without participating in the program. The most common response from partial participants as to why they stopped participating (48%) was that the projects they were pursuing were not cost effective, even with existing PSE program incentives (Figure 3.26). A few participants still hoped to participate in the program eventually and were addressing internal roadblocks in order to do so. Another 16% had to back out of the program due to external factors unrelated to PSE.

Figure 3.26. Partial Participant Reasons for Ending Participation

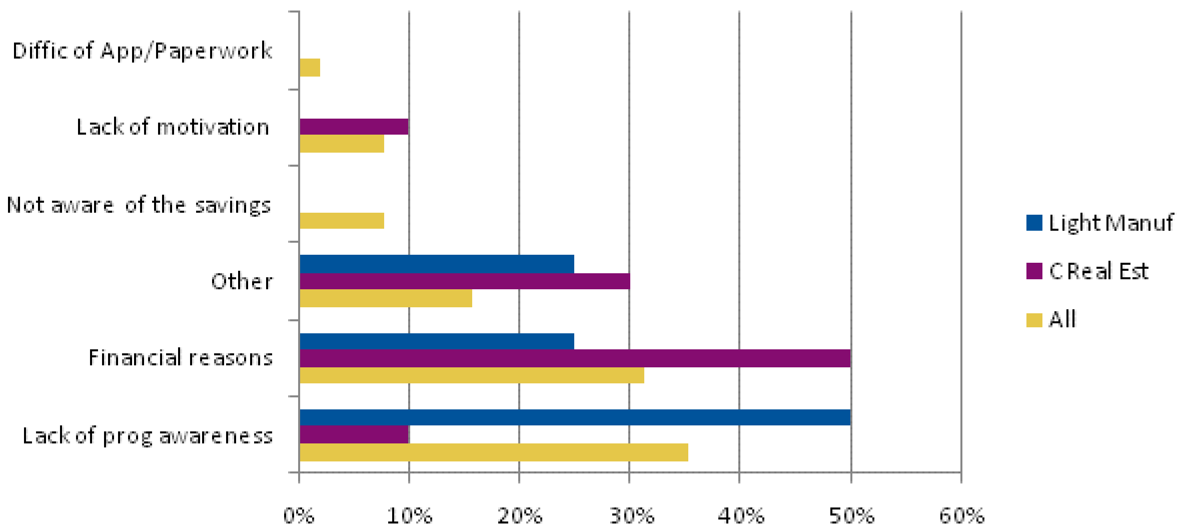


Funding and lack of information were customers' two most cited reasons for **non-participation**. Thus, increasing program information, and either increasing incentives or better explaining the financial benefits, should increase participation, especially since low maintenance costs and energy savings are most commonly cited as the main benefits of participating by non-participants. In fact, **50% of non-participating customers indicated that they are very likely to participate in the program in the future, with another 30% indicating that they are somewhat likely**. This indicates a high potential for nudging these non-participants into action by addressing their main barriers to entry.

Program Barriers

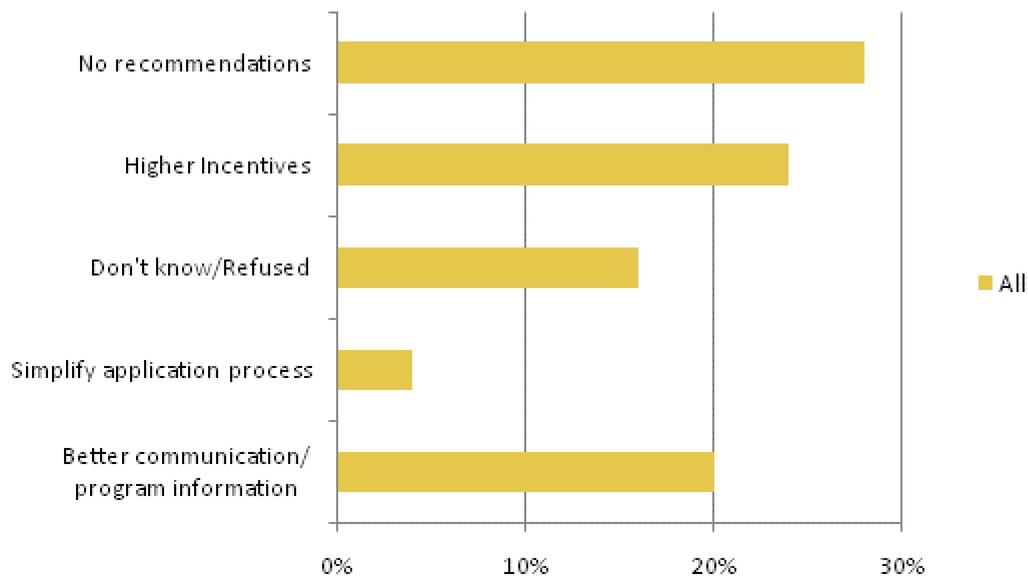
When asked why they thought companies like theirs do not participate in the program, **participating customers** cited a lack of program awareness (35%) and financial reasons (31%) (Figure 3.27). Skepticism and a lack of green prioritization in company management were other frequently mentioned reasons. The commercial real estate customers noted *financial reasons* as the largest perceived potential impediment to participation in their sector while light industry noted a lack of program awareness (two of the four that responded to the question).

Figure 3.27. Participant Perceived Barriers to Participation



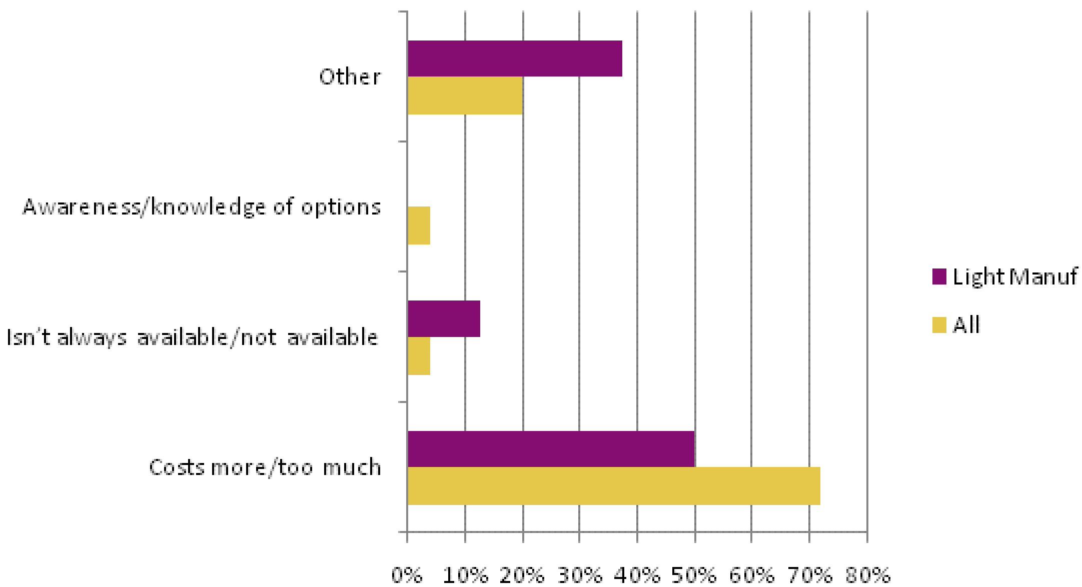
About 28% of the **partial participants** did not have recommendations for how to improve the program, and another 24% said that higher incentives would have kept them in the program (Figure 3.28). This indicates that finances and external factors were often the main reason for these participants dropping out. **The majority of partial participants (81%) did express a desire to participate in the future,** demonstrating that most have not been dissatisfied with the program. However, 20% commented that better communication and program information from PSE would have helped them to participate, and this is an area where PSE can improve. Many who responded that they would like to participate in the future would only do so under certain conditions, most often citing time and cost constraints.

Figure 3.28. Partial Participant Program Improvement Suggestions



About 72% of **non-participants** indicated that the main barrier to installing energy efficiency equipment or changing O&M practices in the program is that it costs more or too much (Figure 3.29). Another 20% of respondents indicated "other", which included funding availability/skepticism, and a lack of time/effort/manpower. The remaining 8% indicated equipment non-availability (4%), and a lack of awareness/knowledge of program options (4%). Initial purchase cost, operation and maintenance costs, energy efficiency, and availability were also ranked by non-participants as important factors in purchasing new equipment.

Figure 3.29. Non-Participant Barriers to Participation



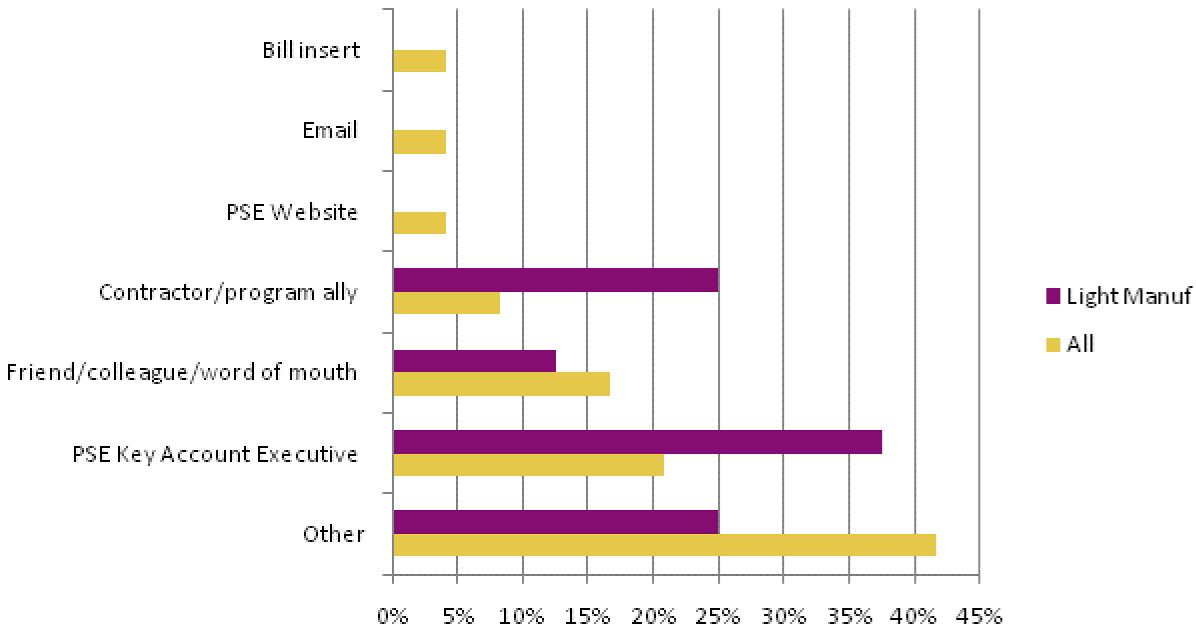
Other survey feedback from **non-participants**, however, suggests that **lack of program awareness** could be a key issue. When asked how familiar customers are with the Custom Grant Program, 45% indicated "not very familiar" and another 36% said they were "somewhat familiar" while an additional 9% were "not at all familiar." Only 9% of non-participants were "very familiar" with the program. Light manufacturing customers were not very familiar to somewhat familiar in most cases (33% and 50%, respectively).

When asked to indicate the main reasons for non-participation (in 2009 and 2010), 64% of non-participating customers cited "other" reasons, including previous participation, lack of funds, and difficult building type as impediments. The second most cited reason (18%) was a lack of information and awareness of the program. Notably, the one light manufacturing non-participant customer that wasn't moving and hadn't been involved with the program before (and was thus a potential new candidate), reported a lack of program awareness. Of the three people that responded to how the custom grant program could be improved, each indicated the need for more publicity and information (specifically on the rate of return, ROR). Two of those were light industrial customers.

Program Awareness and Outreach

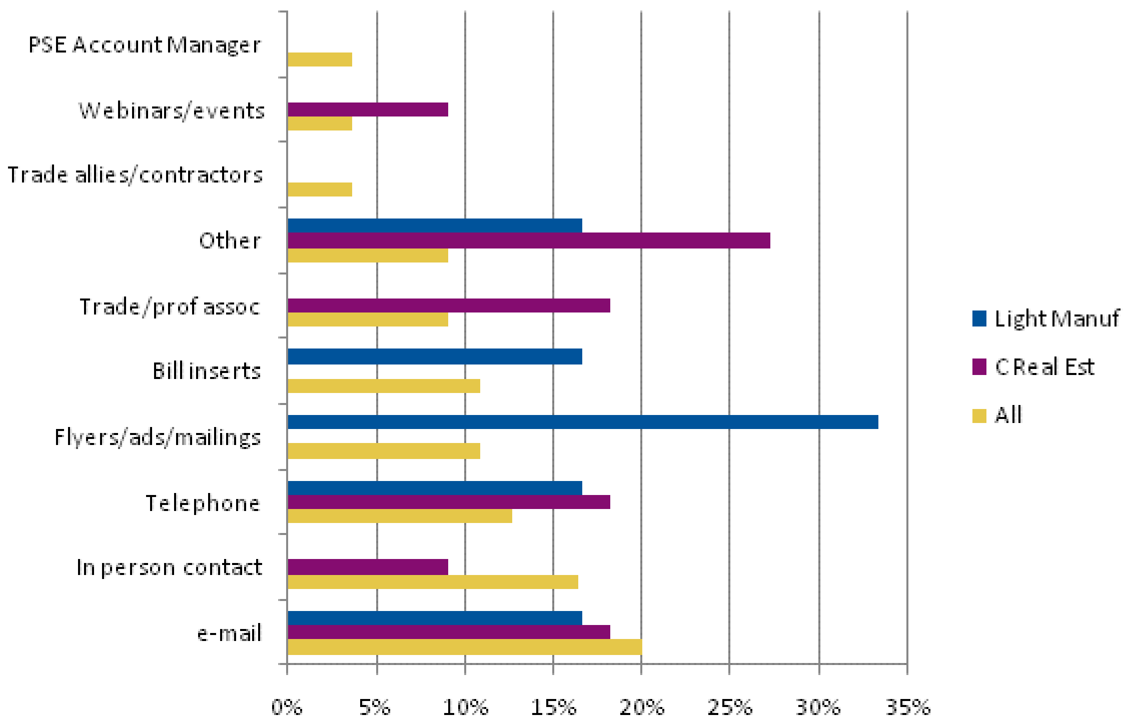
A total of 68% of **non-participating customers** indicated that they do not recall seeing or receiving any marketing materials or information about PSE's Custom Grant program. This reflects in part the fact that the survey team contacted customers of all sizes, a number of whom would not necessarily have been targets for the program. Most people that did hear about the program did so through "other" means (42%), which included through vendors, Internet research, and a newsletter (Figure 3.30). Other sources of information included a PSE Key Account Executive (21%) and word of mouth (17%). Light industry customers, on the other hand, most often heard about the program through their PSE Key Account Executive. Note that only 4% of all customers that knew about the program heard about it through email and another 4% through bill inserts. These means were reported in this survey as the most popular contact methods among non-participants (and e-mail among participants), as discussed in the following sections.

Figure 3.30. Non-Participant First Source of Program Information



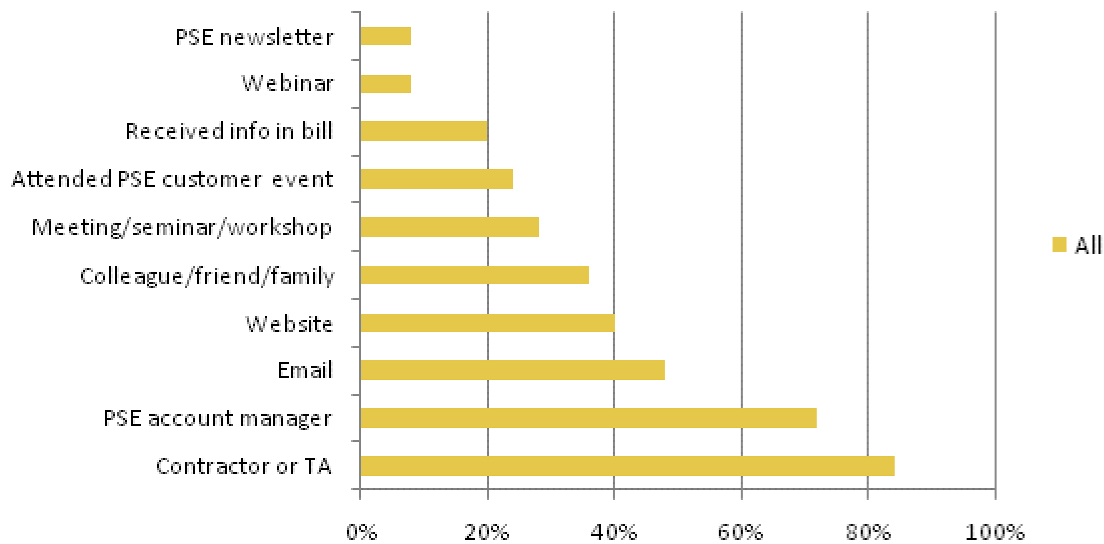
Participants overall indicated email, in-person contact, and telephone calls were the top three ways to reach customers (Figure 3.31). Two of six light industry customers noted flyers/ads/mailings as the best way to reach them, with the remaining four respectively mentioning email, bill inserts, telephone calls, and industry and trade publications. Commercial real estate customers said email, telephone contact, and trade/professional associations and informational meetings were the best way to reach them.

Figure 3.31. Participant Preferred Contact Methods



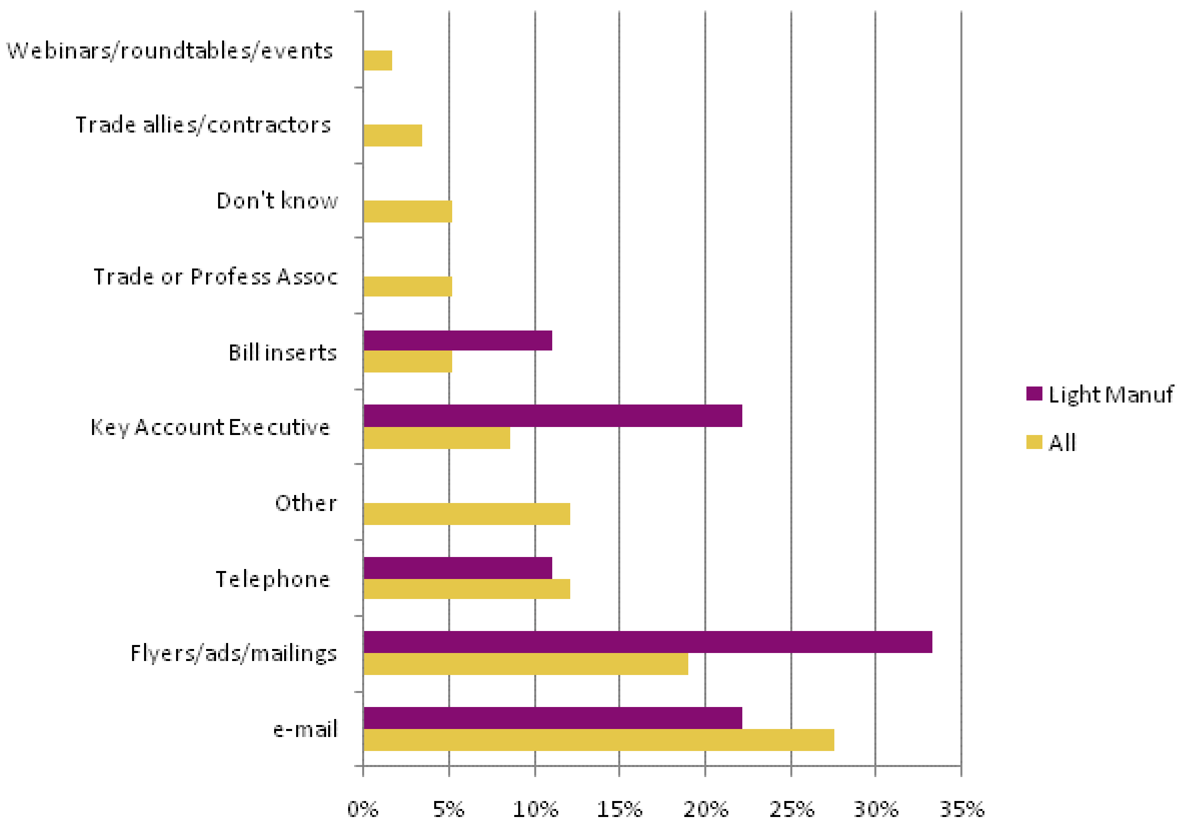
Partial participants had heard about PSE's program in many ways. The most common were through a contractor or trade ally (84%) or a PSE account manager (72%) (Figure 3.32). When prompted for other ways, the most common response was through vendors. However, only 8% of partial participants indicated that the best way to reach them was through trade allies or contractors; more specified that email (48%) or in-person contact (24%) was the most effective way to contact them.

Figure 3.32. Partial Participant Initial Sources of Program Info



Overall, **non-participants** also indicated that email was the best way to reach them (28%) (Figure 3.33). Other top choices were flyers/ads/mailings (19%), telephone calls (12%), and "other" (12%), which included suggestions for in-person visits, ads, and targeting management. The light manufacturing customers seem to prefer flyers/ads/mailings, key account executives, and email as the main means of contact.

Figure 3.33. Non-Participant Preferred Contact Methods



Key Messages

The top reason (52%) **participants** gave for participating in the program was that it is good for saving energy and generating money savings. The monetary incentive was the second most cited reason (24%). Other reasons customers participated were that the program and the experience were positive (10%) and that participating was good for a company's image (7%).

Partial participants' view of participation benefits indicates again that the financial aspects of program participation are very important to customers. A total of 52% cited utility savings as a benefit, and 40% cited the rebate/incentive. Few highlighted the environmental benefits (8%) or advantages of higher quality new equipment (12%).

About 37% of **non-participant respondents** indicated that lower maintenance costs are the main benefit to participating in energy efficiency programs like the Custom Grant program. Energy savings were the next most important perceived benefit, with better quality new equipment in third. Lower maintenance costs were the clear selling point for Light Industry non-participant customers as well (50% compared to the next highest percentage, 17%). Rebate/incentives were listed as the main benefit by only 11% of the respondents. Notably, none of the non-participant customers indicated that the main benefit to participating was that it's good for the environment. These non-participants are thus less likely to be driven to participate due to environmental concerns, unlike the participants and partial participants who cited environmental benefits. Instead, savings associated with lower maintenance and energy expenditures are the most solid selling points for both participating and non-participating customers.

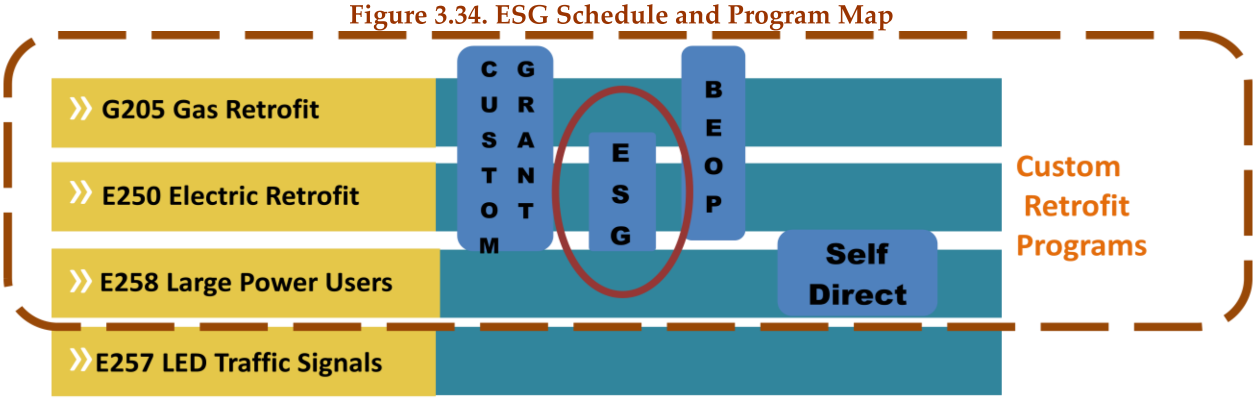
The top two participant benefits claimed overall were new better quality equipment gained through the program and lower maintenance rates. Customer satisfaction and publicity opportunities were also noted as other benefits. Whereas Light Manufacturing customers also most frequently noted better quality new equipment as one of the program benefits, Commercial Real Estate customers noted customer satisfaction and publicity opportunities as top additional benefits of participating in the program. It is interesting to note that fewer Commercial Real Estate participants, 50%, cited additional benefits than all respondents, though again that is half of a very small sample.

3.3.2 EnergySmart Grocer Program

PSE's EnergySmart Grocer (ESG) program funds audits which are used to advise grocers on energy-efficient retrofits of their existing refrigeration and related systems. The program provides grocers with free energy audits that yield information about efficient refrigeration technologies and opportunities for energy savings in the form of an Energy Savings Report (ESR). The EnergySmart Grocer program can assist further by reviewing contractor bids and advising on technical options, many of which are also incented to help offset the upfront investment in new equipment. PSE's program is delivered by Portland Energy Conservation, Inc. (PECI) which provides technical sales staff to call on customers as well as engineers to perform the audits, and also processes the applications, verifies the installations and pays the incentives to customers.

This report subsection details Navigant's findings regarding the EnergySmart Grocer program which is funded solely by Schedule 250. (Figure 3.34)

Figure 3.34. ESG Schedule and Program Map



Navigant's process evaluation for the ESG program draws upon the following sources for these findings:

» Draft EnergySmart Grocer program logic model

» Program database mining

» Program management and implementation in-depth interviews

» Benchmarking and best practices research

» Trade ally in-depth interviews

» Customer surveys

The EnergySmart Grocer program accounts for 19% of total custom retrofit C&I savings, with all measures under this program being refrigeration-related. The program had 127 participants over the two years who implemented 812 measures in total. The average project saved almost 60,000 kWh. The program's average incentive cost per first kWh saved was $0.16, lower than the average of $0.25 for the four schedules evaluated by Navigant. (Table 3-19)

Table 3-19. EnergySmart Grocer Program Overview

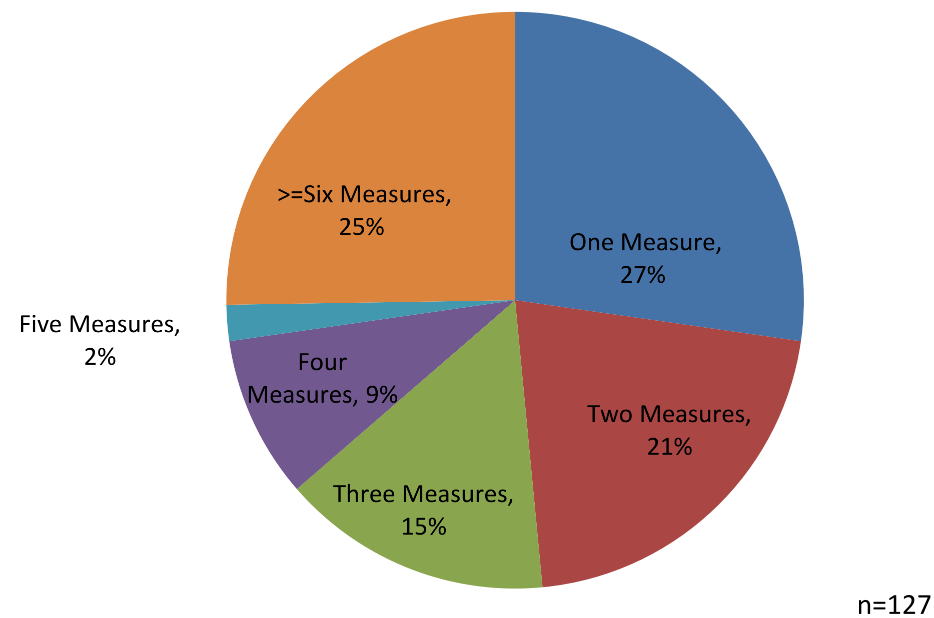
Program	Total					
	GWh Savings	% Electric Savings	Therm Savings (MDth)	% Gas Savings	# Participants	% Participants
EnergySmart Grocer	31.0	19%	0.0	-	127	15%

Program	Number of Projects	Average Per Project			Overall Average	
		Grant Amount	kWh Savings	Therm Savings	$/kWh	$/Therm
EnergySmart Grocer	518	$9,007[1]	59,923	0	$0.16	$0.00
Four Schedule Total	**2,060**	**$18,715**	**77,822**	**1,019**	**$0.25**	**$4.44**

[1] ESG grant calculations are based only on the 7 ESG refrigeration projects that PSE administered. They do not reflect kWh savings for ESG projects processed by PECI, for which data is unavailable. These account for 19% of all kWh savings and approximately 99% of all ESG kWh savings.

The ESG program appeared to be the most successful at generating deep savings, as it has the highest number of measures implemented per participant on average during 2009 and 2010. One quarter of ESG participants implemented six or more measures during this period as shown in Figure 3.35 below.

Figure 3.35. ESG Program Measure Frequency Distribution

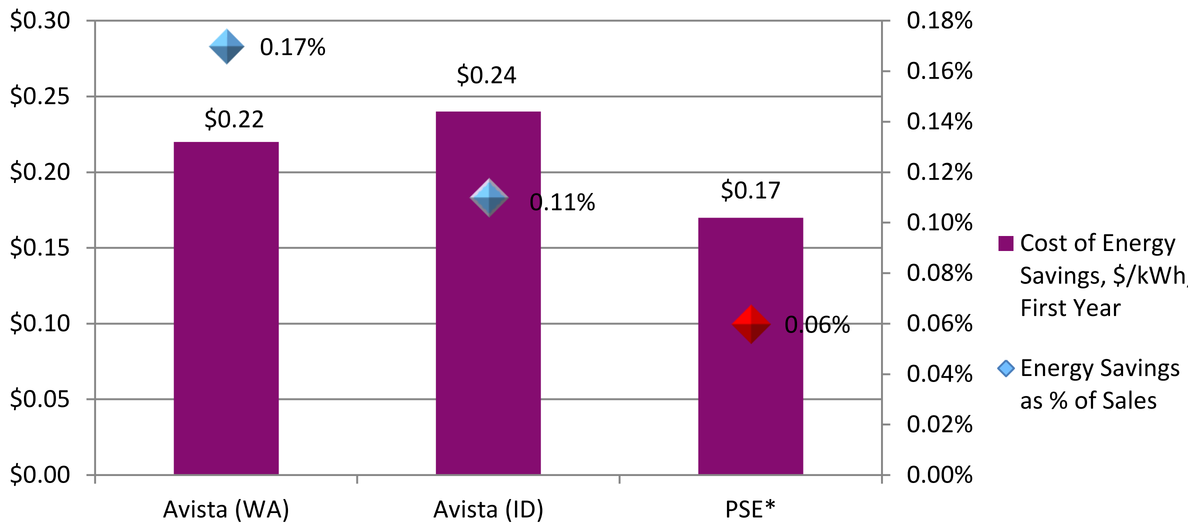


Source: CSY Master Database, May 18, 2011. Navigant analysis.

3.3.2.1 Benchmarking and Best Practices Findings

In the C&I program benchmarking Navigant sought to compare PSE's savings and cost with the other benchmarked utilities who had implemented a similar program. Among the utilities PSE was benchmarked against, only Avista Washington and Idaho reported savings for a Smart Grocer program. Both of those programs reported higher savings as a percent of their C&I usage, while their costs were also somewhat higher. (Note, PSE's costs in the below chart reflect only costs related to incentives, that is, no non-incentive costs.) (Figure 3.36)

Figure 3.36. EnergySmart Grocer Benchmarking Results



*Incentive only 2009-2010 average. Navigant PSE data-mining analysis

Avista Washington's Smart Grocer Program achieved higher savings than PSE's in both Washington and Idaho likely due largely to a wider program breadth. Avista includes measures other than refrigeration in their program, including gas measures. Avista also targets new store construction and has found it to be very effective. Avista did find that smaller customers (convenience stores and commercial kitchens) tend to buy used refrigeration systems, so they no longer target them to the same degree.

3.3.2.2 Trade Ally Feedback: Program Efficiency

This section analyzes the in-depth trade ally interview responses and highlights the key results for the EnergySmart Grocer program in three areas: Program Efficiency, Marketing and Outreach, and Enhancement Opportunities. Five trade allies provided feedback about the ESG program.

Overall, trade allies reported moderate satisfaction with the program, giving it an average satisfaction rating of 2.05 (out of 4, with 1 being the highest possible score). All allies reported increased business as a result of the program, and many increased their staff as well.

Though trade allies participating solely in the ESG Program were generally satisfied with its efficiency, those who also participated in the C&I Retrofit program perceived higher inefficiency in the ESG program. One ally commented that PECI required more paperwork and inspections than the Custom Grant program, but that the same equipment could get much higher incentives through the Custom Grant program.

Table 3-20 details responses regarding specific program characteristics impacting efficiency.

Table 3-20. Trade Ally Feedback on EnergySmart Grocer Program Efficiency

EnergySmart Grocer: Program Efficiency	
Application Process	Most allies find applications easy and quickly processed.
Usefulness of Required Inspections	Some trade allies are frustrated with the large number of required inspections, though one found the double-check helpful. Other utility programs allow TAs to document upgrades with photographs instead of requiring a third party inspection.
Paperwork Issues	Both trade allies who also use the Custom Grant program find ESG documentation requirements excessive. They also report that ESG options are restrictive. One strongly believes that PECI introduced inefficiencies.
Payment process	Most TAs were largely satisfied with grant processing speed. However, all reported delays, some up to a month beyond scheduled payments, and this was a major issue for one ally.
Impact on contractor	All trade allies reported increased business, and many hired additional staff specializing in energy efficiency as a result of the program. Few changes in stocking practices.

3.3.2.3 Trade Ally Feedback: Marketing and Outreach

Although some trade allies preferred to use their own marketing materials tailored to their customers, many commented favorably on the case studies in the brochures and requested more numerical examples to help customers understand the long-term benefits of efficiency measures. Another suggestion was to give participants an ESG program sticker to display in windows, alerting customers to their efficiency efforts and promoting the program. As with the other programs, trade allies expressed a desire for PSE to play a more visible role in the program, recruiting customers and increasing advertising efforts.

Table 3-21 details responses on program training, marketing, and outreach.

Table 3-21. Trade Ally Feedback on EnergySmart Grocer Marketing and Outreach

EnergySmart Grocer: Marketing and Outreach Effectiveness	
Training availability and usefulness	Half of the trade allies had received some training, which one found useful. Others expressed a desire for marketing training and advice on paper processing details.
Availability and quality of marketing materials	Most had received brochures from ESG and found them useful. Some commented that their marketing is too customer-specific to use the ESG brochures. Others found that the case studies highlighted in the brochure were useful in sales.
TA Outreach Desired	Half of the respondents expressed desire for additional marketing materials with clear and quantitative savings examples. Some also wished for introduction of new measures to broaden scope and help getting in touch with customers.

3.3.2.4 Trade Ally Feedback: Enhancement Opportunities

As in the C&I Retrofit program, trade allies who sell a specific product and use a similar process for most of their customers were more satisfied with the program. Correspondingly, trade allies who work on a variety of projects have greater difficulty predicting the value of potential incentives and are more likely to get tripped up in paperwork. Program simplification and transparency about incentive amounts would help these TA's. Another consistent response was a desire for an expansion of the program to cover more LED lighting options.

Table 3-22 highlights the main areas where TAs felt PSE could improve the program.

Table 3-22. Trade Ally Feedback on EnergySmart Grocer Program Enhancement Opportunities

TA Feedback: EnergySmart Grocer Program Enhancement Opportunities	
Problem or Obstacle Identified	*Opportunity*
Some customers view the program as a disruption to business that they do not have time for	Streamline process, especially on-site inspections, increase customer education
Many qualified customers, especially smaller stores, cannot afford their share of measure costs	Investigate ways to help customers finance measures
Some TAs feel limited by current measure scope	Expand program to include new technologies, namely LED lighting and a wider variety of (unspecified) efficient refrigeration measures
Smaller grocery stores with international owners run into language barrier with PSE	PECI should look into hiring multilingual staff to limit barriers to these grocers
Delayed payments have caused some TAs to have financial problems	Expedite payment processing or be accurate about expected payment dates—e.g., within 45-60 days instead of 30
Many TAs reported that program can take a long time, paperwork required is time consuming (principally re-submittals due to mistakes), and amount of incentive is difficult to predict	Make incentive calculation process more transparent so that trade allies can present customers with options sooner

3.3.2.5 Customer Feedback

Customer feedback on the EnergySmart Grocer (ESG) program reflects interview results from five active participants, five participants with below average participation in the past two years, and eight customers who did not participate at all during the past two years, half of which claim to have never participated. In all cases, the interviews were conducted with a primary energy efficiency decision maker in the organization. The findings are summarized in two tables, one addressing program satisfaction and opportunities, and the other addressing marketing issues.

As detailed in Table 3-23 below, overall participant satisfaction with the ESG program is very high, with all ten customers participating over the past two years very satisfied with the program. This level of satisfaction is reinforced by all participants reporting plans to participate in the program again in the future. Also consistent with high participant satisfaction, many participants offered no suggestions for program improvement, and there was no common theme among the few improvement suggestions offered.

The most commonly cited barrier to participation was cost, while lack of program awareness was cited by half of the non-participants. One notable comment, however, is that future participation will depend on the introduction of more measures. This suggests that participants believe that they have either implemented all available measures or all cost-effective measures, and future activity will depend on the offering of additional cost-effective measures.

Table 3-23. Participant Satisfaction With ESG Program

Factor	Feedback
Overall Satisfaction	• All 10 customers who participated over the past two years indicated they were "Very satisfied" overall with PSE's custom grant program. • Those participants whose participation rates were lower than average (based on number of measures installed) indicated that this is because they have already installed all of the cost-effective measures. • All participants indicated that they plan to participate in the program again in the future *when more measures are introduced.*
Key Barriers to Participation	• The most commonly cited barrier to increased participation was the upfront investment, a universal concern of all non-participants and cited by one active and two less active participants. • Four of the more active and one less active participants indicated there were no drawbacks to participation in the ESG program. • Program awareness was an issue for four of the least active participants, where four of the eight had not heard of the program. One moderately active participant commented that he hadn't participated much recently because he hadn't been contacted by the program administrator. • Business climate was cited as an issue by a couple of the moderately active participants, while one other commented that he had not seen any benefits from a previous measure, but this could have been due to a rate increase.
Program Processes	• Customers were generally very satisfied with the ESG program processes. • All participants indicated that the application process was simple, and the majority agreed that requesting program services was easy, and program staff were helpful. • Only one participant disagreed with the statement that "requesting program services from PSE was easy".
Opportunity for Improvement	• Consistent with high levels of program satisfaction, respondents provided limited feedback about improvement opportunities, and any suggestions ranged widely in nature. • Among the most active participants, one wanted better communication about specific measures while another desired more measures. • Among less active recent participants, two suggested that a simplified and/or electronic application process would be useful while one suggested offering no-interest or low-interest financing.

Incremental focus on marketing and outreach is an area of opportunity for PSE. Customer feedback indicates that the most effective approach to inform customers about PSE's program is in person, though smaller participants indicate that bill inserts and fliers are effective. Key marketing messages include the opportunity to save both money and electricity. More detailed customer feedback relating to ESG program marketing and outreach is summarized in Table 3-24.

Table 3-24. ESG Program Marketing and Outreach

Factor	Feedback
Awareness/ Effectiveness of Marketing Materials	• Bill inserts and fliers were most useful for smaller customers where the decision maker is likely to see the bill. • E-mails had been seen and recalled by more customers than events or meetings. • The PSE website was cited less as a source of program material than might be expected.
How Best To Reach Customers	• For recent participants contractors were the most common source of program information. • Participants consistently reported that the two best ways to reach them are via a PSE representative and/or an in-person visit. • One respondent indicated that there were too many parties coming with information about ESG, and it undermined his efforts to approach ESG in an integrated way.
Marketing Message	• The reported main benefits from participation in ESG are saving money and saving electricity, with saving money being the most consistent response across all those surveyed. • Environmental concerns was the next most common response, though not a universal concern. • Among non-participants, all who responded (7 of 7) indicated both the initial purchase cost and operating cost of new equipment is “very important” in making the decision to install. Less so, though still important were energy efficiency and product availability, followed by product aesthetics.

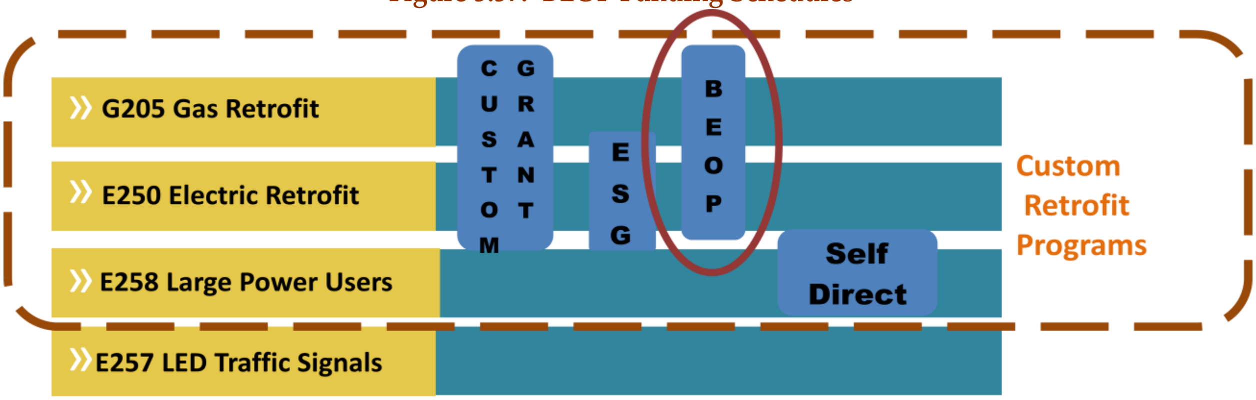
3.3.3 Building Energy Optimization Program (BEOP)

PSE’s Building Energy Optimization program (BEOP), a retro-commissioning program, targets persistent, cost-effective, energy-saving changes in existing building systems and operations. The program provides funding and authorizes third party agents to evaluate the operation of existing building systems that need to be recalibrated over the life of the building as changes in occupancy and other factors lead to comfort issues and system inefficiencies. Building managers are trained in the proper maintenance of the changes, and a training manual is created to ensure the knowledge is retained with the building, beyond any staff changes. In addition to funding the evaluation, PSE incentivizes participants to maintain the new, energy efficient controls, by offering a cash bonus one year after the initial changes are implemented if the energy savings are maintained.

This O&M-focused program was redesigned in 2009 in an attempt to increase participation. A significant change was the creation of partnerships with retro-commissioning agents, designated contractors that PSE has qualified through extensive research to do this work. In addition, the incentive structure was changed and incentives were increased to attract participation. The program targets buildings over 50,000 square feet that are at least 3 years in age with 75% occupancy.

BEOP projects can be funded from Schedules G205, E250 and E258 as shown in Figure 3.37 below.

Figure 3.37. BEOP Funding Schedules



Navigant's process evaluation for BEOP draws upon the following sources for these findings:

- Draft BEOP logic model
- Program database mining
- Program management and implementation in-depth interviews
- Benchmarking and best practices research
- Trade ally in-depth interviews
- Customer surveys

As Table 3-25 shows, the BEOP program accounted for only 2% of all C&I retrofit program kWh savings in 2009 and 2010. The average incentive cost per kWh saved was $0.04, and average cost per Therm is $0.13, both significantly lower than the overall average for the four schedules evaluated. During this period, the program had eight participants complete 11 projects, some projects having been initiated under the previous program structure.

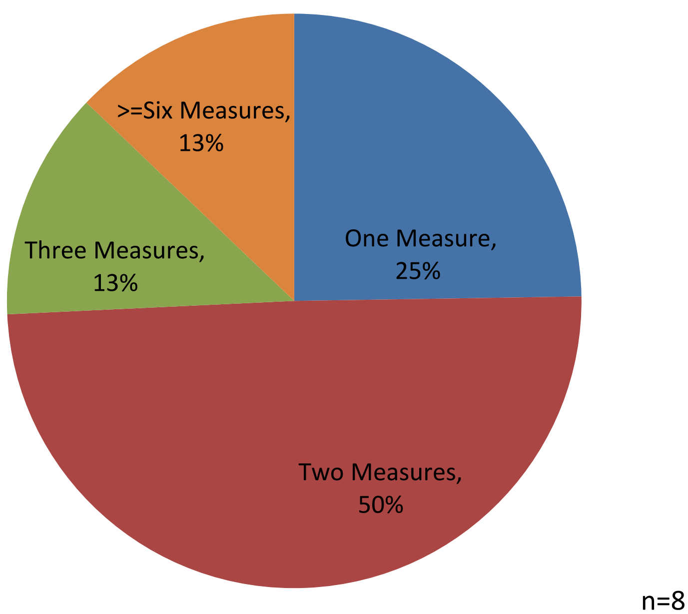
Table 3-25. Building Energy Optimization Program Overview

Program	Total					
	GWh Savings	% Electric Savings	Therm Savings (MDth)	% Gas Savings	# Participants	% Participants
BEOP/ RCx Program	2.5	2%	3.9	3%	8	1%

Program	Number of Projects	Average Per Project			Overall Average	
		Grant Amount	kWh Savings	Therm Savings	$/kWh	$/Therm
BEOP/ RCx Program	11	$27,304	228,450	3,546	$0.04	$0.13
Four Schedule Total	**2,060**	**$18,715**	**77,822**	**1,019**	**$0.25**	**$4.44**

BEOP and other O&M project participants implemented more measures than the average Custom Grant program participant. Only 25% implemented one measure, while 13% (1 participant) implemented six or more measures. (Figure 3.38).

Figure 3.38. BEOP Program Measure Frequency Distribution

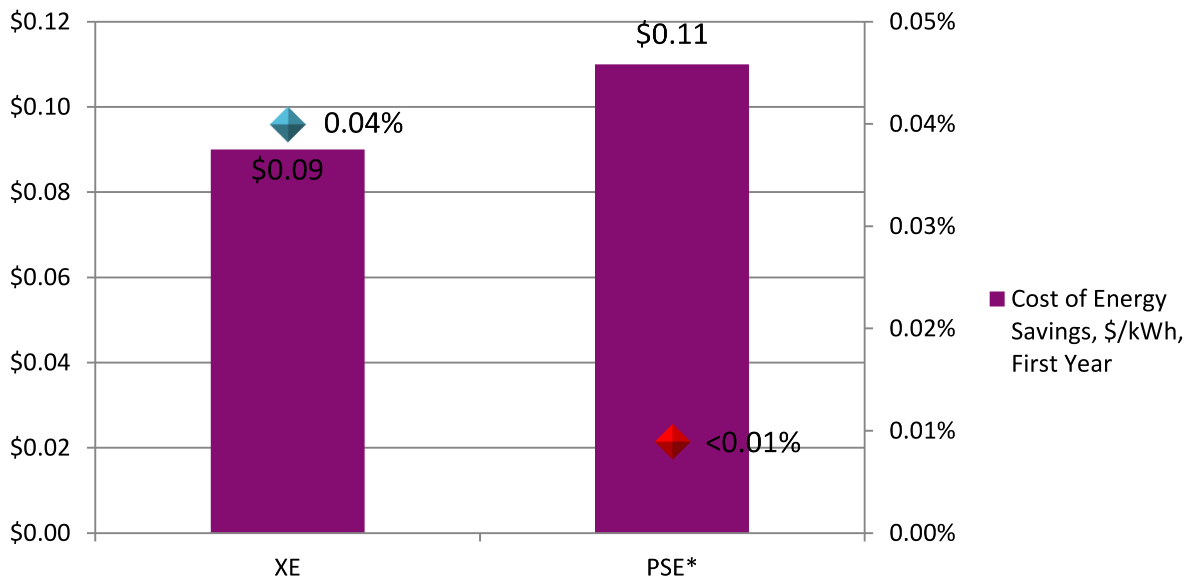


Source: CSY Master Database, May 18, 2011. Navigant analysis.

3.3.3.1 Benchmarking and Best Practices

PSE's BEOP is still relatively young, so any benchmarking of the program with programs that have been around for some time are less meaningful than those that are also in their first few years of operation. The only benchmarked utility to report running a retro-commissioning program was Xcel MN, which has had a program operating over ten years. Although 2009 was not its strongest year, its program savings were four times PSE's and its cost was lower per first year kWh saved than BEOP's. (Figure 3.39)

Figure 3.39. RCx Program Benchmarking of 2009 Results



*Incentive only 2009-2010 average. Navigant PSE data-mining analysis

Xcel's RCx program performance peaked in 2008 when they generated 150% of 2009 savings or 10 to 11 GWh; participation runs at 20 to 40 customers per year with 60 in the pipeline.
Xcel MN has 15 to 20 allies providing applications and 10 which are truly active. The utility does not limit customer size but finds <50,000 square foot customers are less cost-effective. In their experience, a study takes 3 to 6 months to complete and 20 months to implement.

In 2009, Xcel significantly increased their incentives because their target savings were increased significantly. Incentives now include 75% of study cost up to $25,000, $400 per KW or $0.045 per kWh up to 60% of measure cost. Measures with less than a nine month payback are not incented and they do not have a persistence incentive. Xcel (through PECI) offers free training every few months for providers and incents only customer training.

Xcel takes two steps to enhance program efficiency: the utility provides a calculator tool to providers to ease savings estimates and is continually adding measures to the tool. Recently, to make sure the provider looks at everything and to encourage customers to implement more measures, Xcel MN implemented a checklist for providers covering 38 measures. They report that this has been effective at increasing project savings.

Navigant also investigated a younger retro-commissioning program that was relatively successful in its first year after its pilot program year. This program, run by ComEd in Illinois had 14 projects completed in its first full year with savings of 5 to 10% on average. ComEd covers 100% of the study cost up to $30,000 or $60,000 (depending on study cost and savings potential) and requires that the customer commit to spending $10,000 or $20,000 (depending on study incentive). They have no limitations on either the agents participating, or customer size, but find that most participants are 100,000 square feet or larger.

3.3.3.2 Trade Ally Feedback: Program Efficiency

These three sections will analyze the in-depth trade ally interview responses and highlight the key results for the Building Energy Optimization program in three areas: Program Efficiency, Marketing and Outreach, and Enhancement Opportunities. Six trade allies were interviewed about BEOP, two of whom are not currently active program users.

Trade allies were not very satisfied with the BEOP program, giving it an average satisfaction rating of only 2.7 out of 4 (where 1 is the highest possible score). The program has had relatively little economic impact on trade ally staffing, in part because of the program's youth but also because it has been slow to generate new business. Trade allies found this program cumbersome to use and difficult to learn. Though documentation became easier after completion of at least one project, TAs report it still requires an unreasonably long time to fill out and adds significantly to the fees they charge to the customer. They report this often results in costs well above the incentive cap on trade ally study cost. TAs reported that documentation of site visits was a particular problem, as they thought it was unnecessary to report the status of every piece of equipment rather than just any anomalies found.

Table 3-26 details responses regarding specific program characteristics impacting efficiency.

Table 3-26. Trade Ally Feedback on Building Energy Optimization Program Efficiency

Building Energy Optimization: Program Efficiency	
Application Process	Nearly all TAs said that the long validation process is very frustrating and customers do not understand delays; it's hard to predict incentives levels; formatting of forms is unnecessarily difficult.
Effectiveness of Inspections	Providers do the inspections, and many commented that documentation required is too general and takes a long time; not everything required by the forms is relevant to all buildings and projects.
Paperwork Issues	Excessive and strangely formatted documentation adds significantly to project cost for most TAs, and time and money are often wasted in back and forth over report details. TAs with more experience in program (two) have grown used to it, but even for them it is cumbersome.
Payment Process	Most reported that payment processing takes a long time.
Impact on Contractor	All report little impact from this program so far: there have been only a few projects and it is new. Cumbersome nature of the program reportedly limits desire of many TAs to do more projects through it.

3.3.3.3 Trade Ally Feedback: Marketing and Outreach

Many trade allies are still struggling to understand and leverage this program. Although training improvements and increased communication with TAs would be helpful, making the program less cumbersome will likely have more potential for increasing its use. One key opportunity is making the incentive level easier to predict. TAs suggested making incentives performance-based or making their calculation more transparent.

Table 3-27 details responses on program training, marketing, and outreach.

Table 3-27. Trade Ally Feedback on Building Energy Optimization Program Marketing and Outreach

Building Energy Optimization: Marketing and Outreach Effectiveness	
Training availability and usefulness	All have had the general program training offered by PSE, but some reported continued confusion over program qualifications, requirements, and documentation.
Availability and quality of marketing materials	A few reported that marketing materials give the impression that far more of the project costs will be covered. Many do not do much marketing for this program.
TA Outreach Desired	More information on what is needed in project forms, more transparency to make incentives more predictable. One suggested qualifying companies, not individuals, because individuals are not permanent company assets. Greater trust in TAs also desired--make point that they have already been vetted in proposal process.

3.3.3.4 Trade Ally Feedback: Enhancement Opportunities

Nearly all trade allies indicated that the main opportunities for this program will be simplification and clarification of program and incentive structure. Increasing customer education and being more realistic about payment processing periods would also be helpful. Many TAs also feel that PSE ought to trust their judgment more, especially given the rigor of the agent screening process.

Table 3-28 highlights the main areas where TAs commented that PSE can improve the program.

Table 3-28. Trade Ally Feedback on Building Energy Optimization Program Enhancement Opportunities

TA Feedback: Building Energy Optimization Program Enhancement Opportunities	
Problem or Obstacle Identified	*Opportunity*
All report that it is difficult to find customers who will benefit from the program, low customer awareness levels	Increase program marketing, adjust incentive structure to cover more projects, and make incentives more predictable.
Most trade allies' costs are high because paperwork is excessive and poorly formatted	Relaxing formatting and detail required in project documentation to lower TA costs
Many trade allies struggle to understand program requirements and incentives, even after training	Improve training on both processing and technical requirements; consider changing structure to performance-based or other
Some TAs feel limited by having a single employee authorized as the provider	Consider expanding provider status to company or a larger group within each company.

3.3.3.5 Customer Feedback

Customer feedback on the **Building Energy Optimization Program (BEOP)** reflects interview results from 3 active participants and 3 "partial participants." In the case of BEOP participants, partial participants had expressed interest in the program and had given participation some level of consideration, but either had not yet committed or had decided against participation. Interviews were conducted with key decision makers when possible. The findings are summarized in two tables, one addressing program satisfaction and opportunities, and the other addressing marketing issues.

As shown in Table 3-29 below, customers familiar with BEOP had mixed feelings about the program. Those who participated were satisfied with the results, but they and others were concerned about the amount of time required to participate. **Most respondents commented that the program was too complicated, and that paperwork and verification requirements were excessive.** Feedback on PSE staff, however, was universally positive.

Table 3-29. Participant Satisfaction with BEOP

Factor	Feedback
Overall Satisfaction	• All participants are satisfied with their retro-commissioning results; however, many commented that it was a lot more work than they had expected. • Participants indicated that they would nonetheless participate again in the future. • All respondents, unprompted, gave positive reviews of PSE staff.
Key Barriers to Participation	• Participants indicated that the amount of time required to participate in BEOP was significant. • Working with a third-party contractor who is not already familiar with the building also takes time and may cause initial overlooking of some savings opportunities. • Respondents were unhappy with the program requirement to make an uncertain financial commitment with an unknown ROI up front. None of the partial participants could say whether they would participate in the future because of the uncertainty surrounding the up-front funding requirements and the related payback.
Program Processes	• Paperwork and verification requirements were perceived to be more than necessary by some respondents, and time consuming by all. • Most interviewees commented that the program was too complicated. • Program process clarity was cited as an issue by one interviewee.
Opportunity for Improvement	• One interviewee suggested the program should allow incremental adjustments or quick fixes, as opposed to requiring an "all or nothing" approach to RCx, to reduce the participant's investment, still generate savings, and at the same time be a foot in the door for the program and for larger improvements at a later date.

Customer interview feedback related to key marketing and outreach issues is summarized in Table 3-30 below. Highlights include the findings that the best means for outreach to potential participants include the PSE account representatives and customer events, such as the Powerful Business Conference. Case studies distributed through these two channels would seem to be a key marketing approach since participants indicate that BEOP generates significant savings and does so quickly.

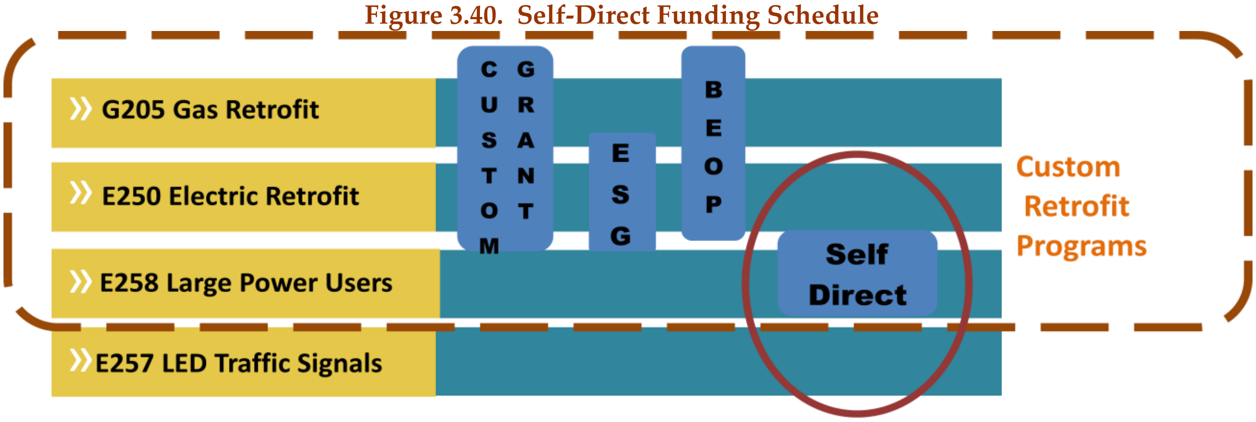
Table 3-30. BEOP Program Marketing and Outreach

Factor	Feedback
Awareness/ Effectiveness of Marketing Materials	• PSE Account representatives were consistently cited as an avenue for information about the program. This was the only avenue through which all respondents indicated they had learned about the program. • While other C&I custom programs did not report significant levels of program awareness though customer events, BEOP participants and partial participants had high levels of awareness through this channel. One respondent cited the "Powerful Business Conference" as the avenue for first becoming aware of BEOP.
How Best To Reach Customers	• In-person contact and PSE Account Managers were cited by all respondents as the best way to reach them.

3.3.4 Schedule E258 Large Power User Self-Direct Program

PSE's Large Power User Self-Direct program is designed to encourage PSE's large power users (approximately 40 customers) to invest in energy efficient projects that they identify and bring to PSE. PSE allocates the incentive funding based on each company's electric usage, and thereby the amount they've paid in; however those customers who do not use their allocation forfeit their funds, which are then combined in a funding pool. Through a combination of applications and proposals, participants may then apply for the unclaimed funds. Each funding cycle runs four years. In 2009 to 2010, approximately 14 of the approximate 40 eligible customers participated in the program. The Self-Direct Program has its own funding mechanism through Schedule E258, though some eligible customers are also eligible for Schedule 250 funds. (Figure 3.40)

Figure 3.40. Self-Direct Funding Schedule



Navigant's process evaluation for the Large Power User Self-Direct program draws upon the following sources for these findings:

» Draft custom program logic model

» Program database mining

» Program management and implementation in-depth interviews

» Results from initial eight in-depth customer interviews

The E258 Large Power User Self Direct program served 14 of PSE's largest C&I customers in this two year period. It accounted for 10% of all C&I savings as shown in Table 3-31 below. The average incentive cost per first year kWh saved was slightly lower than the overall average, at $.23 per kWh.

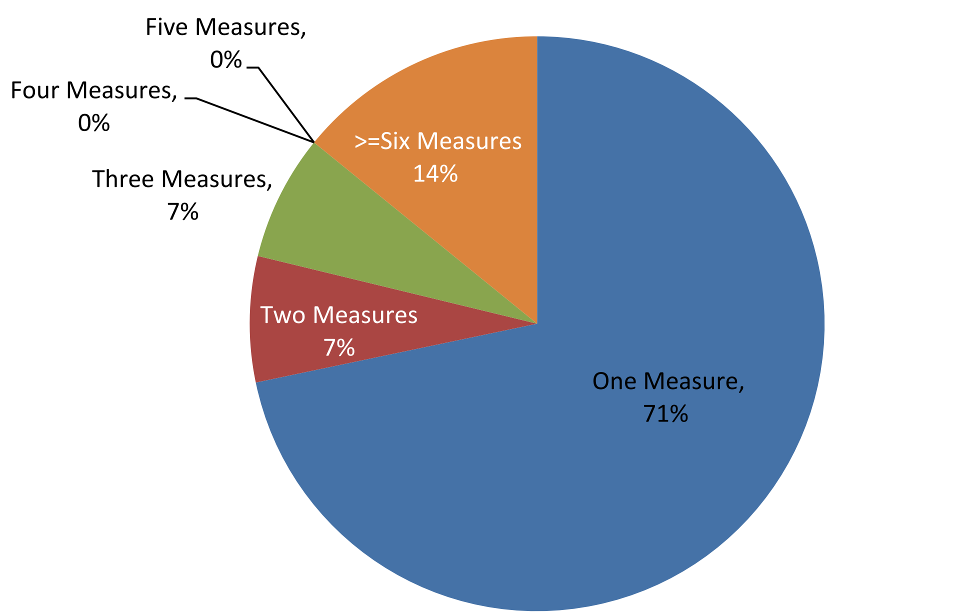
Table 3-31. Large Power User Self-Direct Program Overview

Program	Total					
	GWh Savings	% Electric Savings	Therm Savings (MDth)	% Gas Savings	# Participants	% Participants
Self Direct	16.8	10%	0.0	-	14	2%

Program	Number of Projects	Average Per Project			Overall Average	
		Grant Amount	kWh Savings	Therm Savings	$/kWh	$/Therm
Self Direct	61	$64,732	276,099	-	$0.23	$0.00
Four Schedule Total	**2,060**	**$18,715**	**77,822**	**1,019**	**$0.25**	**$4.44**

The majority of Self Direct program participants implemented only one measure during the two year period. As shown in Figure 3.41 however, 14% implemented 6 or more measures during those two years.

Figure 3.41. Large Power User Self Direct Program Measure Frequency Distribution



Source: CSY Master Database, May 18, 2011. Navigant analysis.

3.3.4.1 Customer Feedback

In-depth interviews to explore market and process evaluation matters were proposed for 12 Schedule E258 customers. Due to some dropouts and pending additional interview completions, feedback from the initial eight of those interviews is summarized below.

Interview feedback indicates that participants are generally satisfied with the program and find program participation easy. (Table 3-32) Participants appreciate the fact that Schedule 258 money is labeled "theirs" as it helps motivate management to authorize projects to get access to those funds. They find it more difficult to interest management in projects that would go through the Schedule 250 process since the money is not "theirs" to be lost. The biggest barrier to doing more projects is other demands on capital. Feedback on how they can be encouraged to participate more was quite limited, confirming that internal issues are the primary barrier.

Table 3-32. Large Power User Program Feedback

Topic	Customer Feedback
Overall Satisfaction	• There is generally good satisfaction among participants. Almost all report they are satisfied or very satisfied with the program. • Customers are motivated to get their own money back.
Ease of Participation	• Participation is relatively easy. A minority found the application too complicated and a drain on resources that could have been applied to the efficiency projects. The calculation of return on investment was singled out as particularly onerous. • Most participants think they are getting good and timely information from their account representatives. A few are effusive about their representatives. • A few participants complained about the speed of incentive payment. One complained that project approval took too long and the project was implemented without incentives.
Biggest Barrier to Doing More Projects	• Other demands on capital. Relatively easy to get funds to leverage their own 258 funds, but harder to go deeper with more projects
Suggested Changes	• Include fuel-switching projects • Make application simpler • Add more prescriptive savings measures

While Navigant received no comments on the May 1, 2011, increase in Schedule 120 Conservation Rider charges for Schedule E258 eligible customers, customer feedback indicates there are many untapped efficiency projects yet to be undertaken. The biggest barrier to Schedule E258 customers undertaking additional projects is other business demands for capital, which presumably have more attractive returns than energy efficiency projects without the incentives.

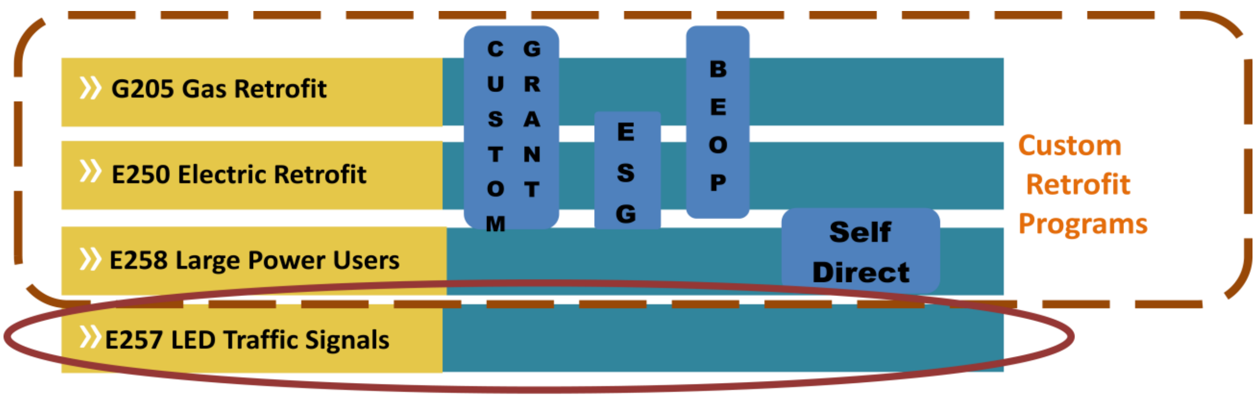
3.3.5 LED Traffic Signals Program

PSE's LED Traffic Signal program is a rebate program that is designed to increase replacement of existing traffic lights with energy-efficient LED traffic lights. The program educates public-sector customers on the benefits of installing red, yellow and green LED traffic signals. PSE provides an LED informational packet along with a rebate application by mail or in person. Customers must receive electric service from PSE to qualify for the rebates, and customers with unmetered accounts must document all connected load at the intersection. New installations are not eligible for an incentive as the LED traffic lights are required by code.

Over this two year period the LED Traffic Signals program operated in an environment in which there was considerable stimulus money that could be applied to these retrofit projects. Program activity reportedly had been declining in prior years but picked up again with the additional funding availability.

The LED Traffic Signals program is funded by Schedule 257 as shown in the below schematic. (Figure 3.42)

Figure 3.42. LED Traffic Signal Funding Schedule



This process evaluation looked only minimally at the LED Traffic Signals program both because the program is expected to be discontinued shortly due to high saturation levels and a transformed market, but also because its savings as a percent of total program savings evaluated is quite small. Consequently, Navigant did not make particular efforts to identify specific program enhancement opportunities or opportunities to increase program efficiency. Program savings and participation levels were assessed in the course of the Team's data mining, and the results are detailed below.

As shown in Table 3-33, the LED Traffic Signals program accounts for 5% of PSE's DSM savings reviewed in this evaluation. With a cost of just $.04 per kWh saved, this program is PSE's most cost effective by a large margin of those four evaluated by Navigant. The 18 participants over this two year period are all cities and counties in PSE's service territory.

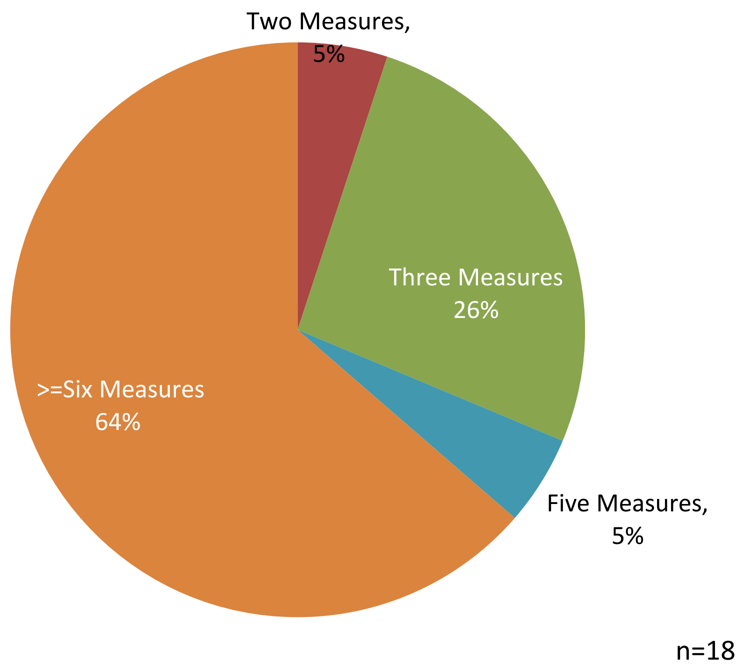
Table 3-33. LED Traffic Signals Program Overview

Program	Total					
	GWh Savings	% Electric Savings	Therm Savings (MDth)	% Gas Savings	# Participants	% Participants
LED Traffic Signals	8.1	5%	0.0	-	18	2%

Program	Number of Projects	Average Per Project			Overall Average	
		Grant Amount	kWh Savings	Therm Savings	$/kWh	$/Therm
LED Traffic Signals	84	$3,736	96,024	-	$0.04	$0.00
Four Schedule Total	**2,060**	**$18,715**	**77,822**	**1,019**	**$0.25**	**$4.44**

Most LED Traffic Signal participants implemented six or more measures during 2009 and 2010 as shown in Figure 3.43.

Figure 3.43. LED Traffic Signals Program Measure Frequency Distribution



Source: CSY Master Database, May 18, 2011. Navigant analysis.

3.4 Conclusions

PSE's custom retrofit programs are generating considerable energy savings, and customer feedback on its longer-running custom programs is quite positive. PSE's programs have penetrated very effectively its largest customers over the past two years while making some inroads among its smaller C&I customers as well. Nonetheless, PSE appears to have a number of opportunities to enhance the efficiency and effectiveness of its custom retrofit programs, particularly its *Schedule E250 programs* – Electric Custom Grant, ESG and BEOP. Benchmarking of 2009 results suggests that PSE spends more (as a percent of C&I revenue) and its programs cost more (per first year kWh saved) than other regional utilities' (with the possible exception of Seattle City Light for which data is not available at that level) and national best practice utilities. While a significant percentage of PSE's program cost is incentives, these high incentives are not driving the high savings levels achieved by other programs which are offering lower incentives. PSE's savings rates (savings as a percent of total C&I consumption) are at about the median level and can similarly be improved.

Navigant's mining of PSE's 2009 and 2010 *electric performance data* indicate that there are particular opportunities for deeper penetration in both Schedule 25 and 31 electric customers generally, and among large customers (all but Schedule 24 and 25) in manufacturing and educational services. Somewhat higher than average participation rates in even the smallest customers in the accommodation and retail trade sectors indicate that where rebate hunters like *Real Win-Win* can be attracted and where a well-designed highly targeted segment program like ESG can be deployed, higher savings rates are possible from even schedule 24 and 25 customers. The high concentration of program activity in PSE's most active trade allies also suggests that there are opportunities to further leverage the balance of less active trade allies.

PSE's *Schedule 205 Custom Gas program* is a top performer regionally in 2009 based on Navigant's benchmarking in spite of its low rate of savings relative to its companion electric program. Navigant's PSE gas data mining indicates that considerable savings opportunities remain and that large customer opportunities are likely to be most notable in the real estate/leasing and other services (except public administration) sectors.

Navigant's evaluation of PSE's other individual programs' performance revealed a wide range of variability:

- » The ESG program has obtained deeper savings than PSE's other programs, but its results compared to Avista's Smart Grocer program suggests there may be considerable remaining savings opportunity in new construction and non-refrigeration measures. PSE does not appear to be leveraging either directly or indirectly PECI's considerable presence at these customers' premises to capture savings from other measures.

- » BEOP is clearly a program in an early stage with tremendous potential. Compared to at least one other program of similar age BEOP has completed fewer projects and has fewer in the pipeline. While it is unclear why this may be the case, it's more complex incentive structure and it's qualifying of providers may to have contributed to the lower number of projects completed and in the pipeline.

» The LED Traffic Signals program is a very low cost source of limited savings, but may very well merit discontinuation if the market has been transformed.

» The Schedule 258 Large Power User Self Direct program brought in relatively large projects that commanded lower incentives per kWh saved than custom grant projects (excluding BEOP and ESG.) The Self Direct program is notable as well for receiving very positive feedback from those six customers contacted to date, who also expressed strong interest in seeing the program continue.

Trade ally feedback varied by program as summarized in Table 3-34 below. Virtually all trade allies interviewed regarding the BEOP program had multiple suggestions for program improvement which program management is aware of and reviewing.. TA feedback on both the Custom Grant and ESG programs was generally favorable, though TAs believe the Custom Grant program suffers from lack of PSE marketing and outreach as well as long turnaround times.

Table 3-34. Highlights of Trade Ally In-depth Interviews

Element	TA Feedback	TA Suggestions to Improve
Overall satisfaction	Most ESG and Custom Grant TAs are fairly satisfied, most BEOP agents are less satisfied	Many BEOP agents would like less stringent documentation requirements and relaxation of formatting guidelines.
Ease of participation	Most found participation in ESG and Custom Grant programs easy, though long process was a challenge. Most BEOP agents found program difficult.	Many would like processes to be shorter and more transparent. Most BEOP agents want reduced and simpler paperwork.
Marketing support	Many TAs found PSE's marketing efforts to customers lacking.	Many want PSE to be more active in recruiting customers, and to act and be visible to customers as a partner to TAs throughout projects.
Training support	Many found training helpful. Some desired additional training, and type of training desired varied widely.	Some TAs thought training should be more technical, and some wanted program savings calculations to be more understandable.
Customer feedback To TAs	TAs report many customers are dissuaded by the long application processes and uncertain savings/incentives.	Many trade allies want savings and incentive calculations to be more transparent so that they can more accurately predict incentives for customers.
Greatest opportunity for more savings	The most frequently reported opportunities were LED lighting, commissioning, and outdoor/parking lot lighting.	These options should be more widely covered by incentives, and commissioning program should be improved and expanded.
Greatest opportunity for improvement	Many believe that shorter processing periods, clearer and more understandable processes, and better relationships with PSE are critical to program improvement.	Many, especially those with less program experience, would like to develop their relationship with PSE and understand the program better.

Navigant's best practices research suggests there are a number of areas for PSE to explore that may yield improved program efficiency and effectiveness. An overarching observation is that PSE has done relatively limited program marketing and customer outreach (with the notable exception of Schedule 258 customers.) PECI through ESG quite actively markets its programs through technical sales reps that are calling on former participants and urging them to undertake still additional projects identified in their initial audit. Selected marketing tactics that PSE may wish to explore are detailed in Table 3-35.

Table 3-35. Best Practices Research Findings Highlights

Strategy Component	Tactic	Example
Customer Outreach	Use Account Executives to generate additional projects (tie to compensation)	Avista
	Use call center to sign customers up for audits and compensate staff per audit	National Grid (smaller customers)
	Use Government Affairs/Community Outreach staff to orchestrate community-specific blitz campaigns (around audits)	National Grid
	Use Account Reps to schedule technical sales folks (3rd party) to do facility audits	Xcel MN, AEP OK
	Devise a focused delivery methodology for 200 to 750 kW customers who need more attention	National Grid
	Leverage ESG presence at customers.	Avista
Program Design	Develop segment focused programs targeting high-potential customer segments	Xcel MN/CO
	Perform up front audit (of varying depths) and stage recommended measures	Xcel MN/CO/PECI/AEP-OK
Customer Relationship Maintenance	Develop and use a customer contact system – follow up on audit findings to generate additional measure uptake	PECI
	Maintain records of audit-recommended measures and which have NOT been done	PECI

The aforementioned marketing and sales tactics clearly involve more than increased spending. They could require changes in staff skills and number, information system capabilities and firm compensation. Before embarking on any such deep changes, PSE should look deeply into those organizations employing these strategies to understand all the key surrounding circumstances and determine whether any make sense for PSE specifically. Subsequently an integrated marketing strategy should be developed leveraging and interweaving those components that make sense for PSE.

PSE is quite rightly proud of the care staff engineers take to evaluate project opportunities for its customers. However, with the growth in the custom DSM programs, the staff has had to narrow its focus, eliminating the upfront audits that they used to perform to identify all savings opportunities at a customer and now focusing only on reviewing proposed projects. Engineering staff appears to be somewhat overloaded, and trade allies have commented on the long application and payment processes. There appear to be a number of potential means by which PSE could better leverage its engineering staff and at the same time continue to deliver high quality service to customers.

Table 3-36 presents a number of possible measures PSE could undertake to leverage its engineering staff while at the same time better meeting the needs of its trade allies. Many TA's indicated that having calculators that would better enable them to estimate savings would be very useful. PSE may also wish to selectively bring in third parties to conduct audits to identify deeper savings opportunities and review proposed projects.

Table 3-36. Potential Staff Leveraging Opportunities

Potential Enhancement	Utility Employing
Develop participant screening tools for TAs	Xcel MN RCx
Develop additional calculators	Xcel MN RCx
Identify additional prescriptive measures	MAEC (IA), Xcel MN
Employ a 3rd party to only do customer audit and follow paperwork through	Xcel MN
Employ external engineering resources for selected more complex measures	Avista
Incent customer use of prescriptive path	None identified (speed of payment)

Better enabling PSE's engineers to focus their skills on the most complex of projects seems highly likely to be in the best interest of PSE, its trade allies and its customers. PSE has been working on developing some tools, like its boiler calculator tool, to enable exactly that. The benchmarking analysis suggests that PSE should continue to develop such tools and also to identify custom measures that can be shifted to its rebate program, where applications are processed more quickly and consistently.

Navigant recommends that PSE undertake the following nine steps to enhance the efficiency and effectiveness of its C&I custom retrofit programs:

» ***Recommendation 1***. **Schedule 258 Self Direct Program** is effective at inducing larger customers to undertake energy efficiency programs, and apparently more effective than Schedule 250 funded programs alone would be with these customers. Navigant recommends that PSE continue efforts to restructure this program per recent discussions with the Conservation Resource Advisory Group (CRAG) and, as feasible, consider applying the program concept of "customer's own funding available to be used or lost" to increase participation of larger Schedule 250 customers.

» ***Recommendation 2***. As PSE has correctly concluded, retro-commissioning represents an attractive opportunity for increased energy savings, and Navigant recommends that PSE **continue to focus resources on optimizing** its new (Schedule 205, 250, and, ultimately, 258) **BEOP structure**, including consideration of the following:

  - Simplifying the program incentive structure and documentation requirements per TA and best practice feedback
  - Enhancing program transparency by providing savings calculators to providers
  - Opening the program to additional providers
  - Enhancing marketing materials, particularly case studies

- *Recommendation 3*. PSE should **assess the potential benefits of reallocating resources from Schedule 205 and 250 custom grant program incentives to TA and customer support and outreach.**
    - TAs are looking to PSE for additional marketing and technical support.
    - Case study material appears to be particularly valued.
    - PSE should assess the potential for creating savings calculators for TAs that would reduce the uncertainty around likely incentive levels.
- *Recommendation 4*. Navigant recommends that PSE assess the potential for **leveraging the success of its ESG program**, both through replicating its structure as feasible and better leveraging PECI's presence at grocers.
    - The ESG program yielded implementation of more measures per customer on average during this period than other programs, suggesting that there are program elements that could merit adopting in other programs and market segments.
    - ESG program elements that are common to other strong utility DSM programs include: initial customer audit with timely feedback, staging of measures, customer follow up, and potentially others.
    - PSE should consider expanding PECI's measure portfolio beyond just retrofit refrigeration to gas and other electric measures as well as new construction in the grocery store market segment.
    - Alternatively, PSE should consider developing a mechanism for PECI to communicate potential opportunities outside their measure portfolio to PSE.
- *Recommendation 5*. Navigant recommends that PSE explore **opportunities to increase Custom Grant program efficiency** and reduce application processing time.
    - Possible approaches include identifying additional measures that can be made prescriptive and developing savings calculators to make calculations more consistent.
- *Recommendation 6*. PSE should review the potential to better **utilize its many customer touch points** to market its EE programs.
    - Best practice utilities are organized to encourage Account Executive, Business Segment Manager, Energy Advisor, and Government/Community Relations staff to bring customers into DSM programs.
    - Such plans would need to consider associated implications for staffing, training, compensation, and required skills.
    - Further leverage existing trade ally relationships
- ***Recommendation 7.*** Navigant recommends that PSE continue to invest in enhancing its marketing materials and approach around market segments. PSE has already begun to do so with its EE website redesign and with some targeted marketing materials.

» ***Recommendation 8***. Navigant recommends that PSE confirm and then develop specific strategies and tactics to address its **target market segments**, including potentially the following:

- Manufacturing
- Real estate
- Education
- National chains

Any confirmation should leverage related findings from Navigant's market assessment and could include a deeper review of program uptake to date or in combination a review of current baseline data. Strategies may include target marketing of programs, use of third parties for all or components of program delivery, and use of PSE marketing resources.

» ***Recommendation 9.*** PSE should ensure that its new **program tracking system** provides the functionality required for future program delivery.

- Best practice systems address needs for customer relationship management by engineering staff, maintaining records of past interactions and future opportunities.
- System functionality typically enables tracking of key program delivery metrics, such as application processing time, verification process time, grant payment processing time, and the like, as well as engineering resource commitments and availability.
- The tracking system content should be enhanced to include key trade ally contact information and standardized to ensure consistency in naming conventions to the degree feasible.
- To the extent possible, tracking system should be designed to support future reporting and evaluation requirements

4 Impact Evaluation

This section summarizes the Impact Evaluation methods and findings used to develop measure-, program-, and schedule-level realization rates for the G205, E250, and E258 Commercial/Industrial Retrofit Schedules. Findings from the Impact Evaluation provide PSE staff with the feedback they need to increase program efficacy and to advance the research and policy objectives of PSE staff and the Conservation Resource Advisory Group (CRAG) by providing independent review of program schedule achievements.

More specifically, the Impact Evaluation of PSE's 2009-2010 C&I Program Schedules aimed to characterize Program Schedule specific energy and demand impacts for commercial and industrial retrofit measures, including:

» Quantifying the impacts of all retrofit measures and activities on annual gross energy consumption while accounting for any interactions among technologies.

» Establishing post-implementation performance profiles for installed measures and activities.

» Explaining discrepancies between the results of this study and the *ex ante* savings estimates.

Evaluation metrics and parameters reported through this study include:

» Gross program savings estimates and realizations rates, by fuel type (i.e., kWh and Therms), for retrofit projects.

» Energy usage profiles for C&I technologies metered through on-site Measurement & Verification (M&V) activities.

Table 4-1 provides an overview of the *As Evaluated* realization rates for each of the three Program schedules included through this study.

Table 4-1. Summary of *As Evaluated* Program Schedule Realization Rates (PY 2009 – 2010)

Program Schedule	Program Spending	Ex Ante Savings	Ex Post Savings	Realization Rate
E250 & E258	$39,954,232	152,247 MWh	155,749 MWh	102.3%
G205	$3,864,784	1,424,472 Therms	1,428,745 Therms	100.3%

It should be noted that the project-/program-level realization rates provided in Table ES reflect the difference between expected savings at the time of installation and verified savings more than one year after project completion. And throughout the evaluation, Navigant observed that many participants altered their operating profiles between this timeframe for a myriad of reasons outside the realm of program influence, including:

» **Idiosyncratic Factors –** changes in equipment usage and operating patterns that are unique to a participant's financial health, employee attrition, and corresponding production schedules.

» **Economic Factors** – changes in equipment usage and operating patterns as a result of shifts in industry and economic climates.

The Impact Evaluation explored each of these non-programmatic factors while quantifying their impact on project-/program-level realization rates. Navigant distinguished the impacts from each of these factors through discussions with facility personnel and in-depth file reviews to calibrate responses.

Table 4-2 provides an overview of program schedule realization rates when removing the influence of *idiosyncratic factors* on project level savings. This was accomplished by carefully reviewing the documentation on evaluated projects and comparing the pre-installation assumptions used to develop *ex ante* savings estimates to the *ex post* observations and feedback from facility personnel. In addition to the project input assumptions, Navigant also reviewed the *ex ante* calculation methodologies against industry standards and accepted engineering practices. Finally, Navigant collaborated with PSE to ensure that all available information collected during the participation process was properly accounted for in the *ex post* savings analyses.

Collectively, this information was used to reconstruct the project planning/pre-installation conditions along with the corresponding savings that would have been achieved upon project completion (*As Installed Realization Rate)*. The realization rate metric at this particular point in the program cycle is a significant milestone and of key interest from a stakeholder perspective which warranted this additional level of investigation.

Table 4-2. Summary of *As Installed* Program Schedule Realization Rates

Program Schedule	Program Spending	Ex Ante Savings	Ex Post Savings	Realization Rate
E250 & E258	$39,954,232	152,247 MWh	151,181 MWh	99.3%
G205	$3,864,784	1,424,472 Therms	1,423,047 Therms	99.9%

The *As Installed* realization rates provided in Table 4-2 are **conservative**; the realization rates at the point of installation is an instantaneous metric that cannot account for variability in weather patterns and productions schedules which inevitably drive project performance over time. Accordingly, the *As Installed* realization rates only capture overestimates in the *ex ante* savings methodologies, of which PSE's C&I Program Schedules had limited instances of. More importantly, the *As Installed* realization rates provide insight into the accuracy of the calculations used to forecast savings in the absence of post-installation data. The results of this effort clearly indicate that PSE's EME's are applying mathematically astute methods to the *ex ante* analyses that are consistent with industry standards and accurately predict *ex post* savings estimates.

The C&I sector is particularly sensitive to economic changes because production throughput, occupancy, and operating schedules are driven by customer demand. Similarly, the changes in equipment usage also affect the efficiency of the baseline and replacement technologies incented through PSE's Program Schedules. Throughout the Impact Evaluation, Navigant encountered a number of participant sites affected by these *economic factors*; a majority of which realized lower than expected *ex post* savings estimates.

The subsequent impact of these economic-driven changes on project-/program-level realization rates compound over time because savings estimates apply across a measure lifetime of several years. As such, Navigant recognized the importance of disaggregating the effects of these factors when assessing program performance and developed a robust method that accounted for variations in operating conditions attributed to external economic activity.

For temporary changes in the participant production schedule, Navigant calculated *Economically Adjusted* savings using two consistent baselines:

2.) *Full Production (Ex Ante) Baseline Operating Schedule:* Both pre- and post-installation energy consumption was calculated using the production schedule observed at the time of participation (i.e., full production schedule). . Full-production adjusted operating schedules were derived from a comprehensive review of historic production logs relative to current operating schedules.

3.) *Current Production (Ex Post) Baseline Operating Schedule:* Both pre- and post-installation energy consumption was calculated using the production schedule during the on-site M&V process (i.e., current production schedule).

Table 4-3 provides an overview of program schedule realization rates when removing the influence of economic factors on project-level realization rates. *Section 4.3 Factors Influencing Evaluation Realization Rates* provides a more in-depth discussion of the approach and assumptions used to separate these economic factors.

Table 4-3. Summary of *Economically Adjusted* Program Schedule Realization Rates

Program Schedule	Program Spending	Ex Ante Savings	Ex Post Savings	Realization Rate
E250 & E258	$39,954,232	152,247 MWh	161,230 MWh	105.9%
G205	$3,864,784	1,424,472 Therms	1,428,745 Therms	102.4%

Navigant recognized that economic volatility occurs periodically, and it is no more valid to choose an "up cycle" than a "down cycle" when evaluating Program Schedule performance. By providing a clear distinction between programmatic and non-programmatic factors affecting the realization rate, future evaluation results will ensure a fair assessment of Program Schedule performance over the EUL of incented measures.

Finally, Table 4-4 summarizes the key research objectives addressed through the Impact Evaluation while specifying report locations that expand upon each topic area.

Table 4-4. Impact Evaluation Research Analyses

Topic Area	Research Analyses	Location in the Report
Impact Evaluation Methodology	Measure Prioritization Project File Review Impact Evaluation Sampling Framework On-Site M&V Analysis	Section 4.1
Impact Evaluation Findings/Results	Technology Level Realization Rates Program Schedule Level Realization Rates	Section 4.2
Factors Influencing Evaluation Realization Rates	Idiosyncratic Factors Economic Factors	Section 4.3
Validity and Reliability of M&V Findings	Uncertainties from Sampling Error Uncertainties from Physical Measurement Error Uncertainties from Engineering Analysis Error	Section 4.4
Impact Evaluation Conclusions & Recommendations	Overarching Program Evaluation Findings and Recommendations	Section 4.5
Appendices	On-Site M&V Plans Industry Best Practices in EM&V Evaluation Database Development Quantification of Non-Energy Benefits Review of Cost-Effectiveness Input Assumptions	Appendices

4.1 Methodology

The following subsections provide a detailed description of the evaluation methodologies used in the Impact Evaluation of PSE's 2009-2010 C&I Program Schedules. These methods were developed and informed through an independent review of evaluation Best Practices.[93]

The term "*Best Practice*" refers to practices that, when compared against other practices, produce superior results. In the context of this study, Navigant defined best practices to be those methods, procedures, and protocols which maximized the accuracy and statistical validity of Impact Evaluation findings. And the specific best practices considered in this study were compiled through a review of secondary literature, a comparison of similar programs and evaluation outcomes, and prior evaluation experience. Table 4-5 details the specific reports reviewed through this effort:

[93] See Appendix L - Best Practices for Impact Evaluation Measurement and Verification (EM&V) Cycles

Table 4-5. EM&V Best Practice Studies Reviewed

Organization	Study Name	Publication Year
The Brattle Group	Measurement and Verification Principles for Behavior-Based Efficiency Programs	2011
Ernest Orlando Lawrence Berkeley National Laboratory	Review of Evaluation, Measurement and Verification Approaches Used to Estimate the Load Impacts and Effectiveness of Energy Efficiency Programs	2010
State of California, Public Utilities Commission	Best Practices Benchmarking for Energy Efficiency Programs	2009
Enbridge Gas Distribution	DSM Best Practices for Natural Gas Utilities: the Canadian Experience	2008
Consortium for Energy Efficiency	Energy Efficiency Program Evaluation: A Guide to the Guides	2008
Minnesota Office of Energy Security	Measurement and Verification Protocols for Large Custom CIP Projects - Version 1.0	2008
Northern California Power Agency	E, M &V Best Practices: Lessons Learned from California Municipal Utilities	2008
National Action Plan for Energy Efficiency Leadership Group	Model Energy Efficiency Program Impact Evaluation Guide: A Resource of the National Action Plan for Energy Efficiency	2007
State of California, Public Utilities Commission	California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals	2006
American Council for an Energy-Efficient Economy	America's Best: Profiles of America's Leading Energy Efficiency Programs	2003
American Council for an Energy-Efficient Economy	America's Best: Profiles of America's Leading Energy Efficiency Programs	2003

While each report presented valuable insight into best practices within the field of EM&V, Navigant documented, characterized, and prioritized those best practices with the following properties:

» Cross-cutting best practices with a high level of representation across each of the studies reviewed.

» Best practices consistent with past evaluation experience and interviews with program managers in other jurisdictions.

» Best practices demonstrating the most applicability towards PSE's C&I Program Schedules evaluated in this study.

The subsequent M&V methods developed for the Impact Evaluation of PSE's 2009-2010 C&I Program Schedules reflect the outcome of this independent review.

4.1.1 Measure Prioritization

The development of a measure prioritization hierarchy was crucial to ensure the cost-effective allocation of limited evaluation resources towards specific technologies and/or projects of utility interest. Navigant adopted this *Best Practice* for the Impact Evaluation of PSE's C&I Program Schedules.

The first step in the measure prioritization process involved a thorough review of PSE's Program Tracking Databases which store contextual project data along with *ex ante* project savings estimates. In addition to verifying both the consistency and quality of information within the each database, Navigant used the available data to gain a better understanding of the distribution of savings across measure technologies and participant segments. This review focused primarily on verifying the factors that influence *ex post* realized savings estimates, including:

» Quantity of measures installed.

» Capacity of measures installed (e.g., lamp wattage for lighting, tons for air conditioning).

» Contact information for all parties involved – Navigant recommends clearly identifying all parties involved in a savings claim (customer, contractor etc.) and collecting contact information for each. This will help evaluators to easily identify and reach out to the appropriate party for a given task.

» Efficiencies of measures installed (e.g., SEER/EER for air conditioning).

» Unique performance features of the measures installed (e.g., variable speed, low-emissivity, etc.).

» Contextual variables such as building type and square footage, operating hours and usage/occupancy profiles.

The subsequent measure prioritization process involved calculating a unique score for each electric and gas measure category implemented within Program Schedules E250, E258 and G205. A unique score was assigned to each measure category based on the following three prioritization criterion:

» **Distribution *of Ex Ante* Savings** – Navigant calculated the distribution of *ex ante* savings across all measure categories incented through Program Schedules E250, E258, and G205. Measures that contributed to more than five percent of a Program Schedule's claimed savings were assigned a score of 3. Similarly, measures that contributed between one percent and five percent of Program Schedule claimed savings were assigned a score of 2, with the remainder receiving a score of 1.

» **Measure Uncertainty** – Measures with a high level of uncertainty were defined as those technologies which (1) possessed variable operating conditions, (2) yielded significant variability in application claimed savings estimates, and (3) had not been investigated extensively in previous evaluation studies. Measures with the highest level of uncertainty were assigned a score of 3, while measures with the lowest uncertainty received a score of 1.

» **PSE Priority** – PSE also assigned a unique score to each measure category based on utility interest in that measure. This score was dependent upon a host of factors including measure maturity, CRAG feedback, future program planning efforts, etc. Measures of significant priority to PSE were assigned a score of 3, with the score scaling downwards with decreasing priority.

Scores for each criterion were then aggregated across each measure category. Measure categories exhibiting a score higher than 7 points were labeled "Tier 1" measures of higher priority. Measures scoring between 5 and 7 were labeled "Tier 2" measures, while the remaining measures were labeled "Tier 3" measures of lower priority.

Tier 1 Measures were measures for which Navigant recommended adhering to an *enhanced level of rigor* when evaluating impacts. Evaluation methods involved the modeling impacts using end-use metering or billing data consistent with the International Performance, Measurement and Verification Protocols[94] (IPMVP). Electric and gas measure categories designated as "Tier 1" are presented in Table 4-6 and Table 4-7, below:

Table 4-6. Tier 1 Electric Measures

Measure Name	Measure Category	Ex Ante kWh Savings
Lighting	Lighting - Commercial	28,435,838
Lighting fixtures plus controls	Lighting - Commercial	19,175,278
Fluorescent luminaries	Lighting - Commercial	11,915,490
HVAC controls only	HVAC - Commercial and Industrial	6,900,580
Process Modification	Process, Commercial	2,931,838
Other Process - High Voltage Program	Process, Commercial	2,816,568
Energy mgmt. control system	HVAC - Commercial and Industrial	2,551,764

Table 4-7. Tier 1 Gas Measures

Measure Name	Measure Category	Ex Ante Therm Savings
Boilers, hot water GAS	HVAC - Commercial and Industrial	431,309
Heat recovery systems GAS	Heat recovery, Commercial	231,349
Gas Energy mgmt. control system	HVAC - Commercial and Industrial	74,155
Boilers - steam GAS	HVAC - Commercial and Industrial	17,894
Water heater, other gas	Water Heating - Commercial	15,656

Tier 2 Measures were measures for which Navigant recommended a *medium level of rigor* for evaluating energy impacts. The evaluation methods for these measures involved algorithm based energy savings calculations utilizing spot measurement and on-site verification of equipment installation. Table 4-8 and Table 4-9 detail the electric and gas measure technologies that fell into this prioritization tier.

[94] http://www.evo-world.org/

Table 4-8. Tier 2 Electric Measures

Measure Name	Measure Category	Ex Ante kWh Savings to date
Phase 2 - ECM Motors	Refrigeration – Commercial	9,735,506
Phase 2 - Floating Head Pressure	Refrigeration – Commercial	5,185,090
Other process	Process, Commercial	4,565,222
Chiller	HVAC - Commercial and Industrial	4,402,390
Refrigeration	Refrigeration – Commercial	3,802,865
Fans, variable frequency drive	HVAC - Commercial and Industrial	2,837,783
Lighting - High Voltage Program	Lighting – Commercial	2,687,777
HVAC Central equipment	HVAC - Commercial and Industrial	2,448,831
Phase 3 – Cases	Refrigeration – Commercial	2,021,448
Lighting - controls only	Lighting – Commercial	1,974,028
Phase 2 - Floating Suction Pressure	Refrigeration – Commercial	1,707,936
Commissioning, electric - Final 50%	O&M	1,568,240
Industrial Plant Lighting	Lighting – Commercial	1,065,606
Pumps	Process, Commercial	447,888

Table 4-9. Tier 2 Gas Measures

Measure Name	Measure Category	Ex Ante Therm Savings
HVAC Central equip – GAS	HVAC - Commercial and Industrial	146,421
HVAC controls only – GAS	HVAC - Commercial and Industrial	124,645
Gas Process Heating	Process, Commercial	86,420
Other Process – gas	Process, Commercial	56,633
Fans - gas, variable frequency drive	HVAC - Commercial and Industrial	43,267
Roof ceiling insulation GAS	Building Shell - Commercial	39,312
HVAC Unitary equip. GAS	HVAC - Commercial and Industrial	39,193
Commissioning GAS	O&M	30,758
Other GAS	Core Services - Commercial	25,416
Wall insulation GAS	Building Shell - Commercial	19,036
Gas Energy Recovery System	Energy Recovery	6,352

Tier 3 Measures included the remaining measure categories for which Navigant recommended a *lower level of rigor*. The evaluation of these measures involved *desk reviews* of project files and comparisons of input assumptions to industry resources.

To provide additional context, Figure 4.1 and Figure 4.2 graphically depict measure category savings across each Program Schedule and Program Year evaluated in this study:

Figure 4.1. PY 2009 - 2010 *Ex Ante* Electric Savings for Schedules E250 & E258

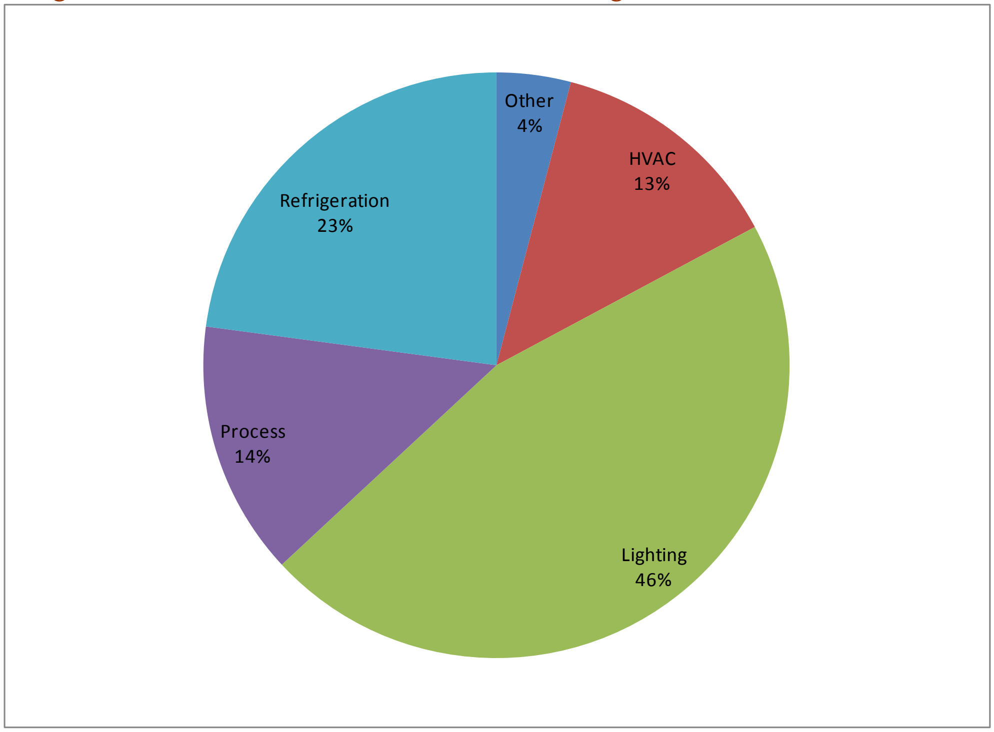
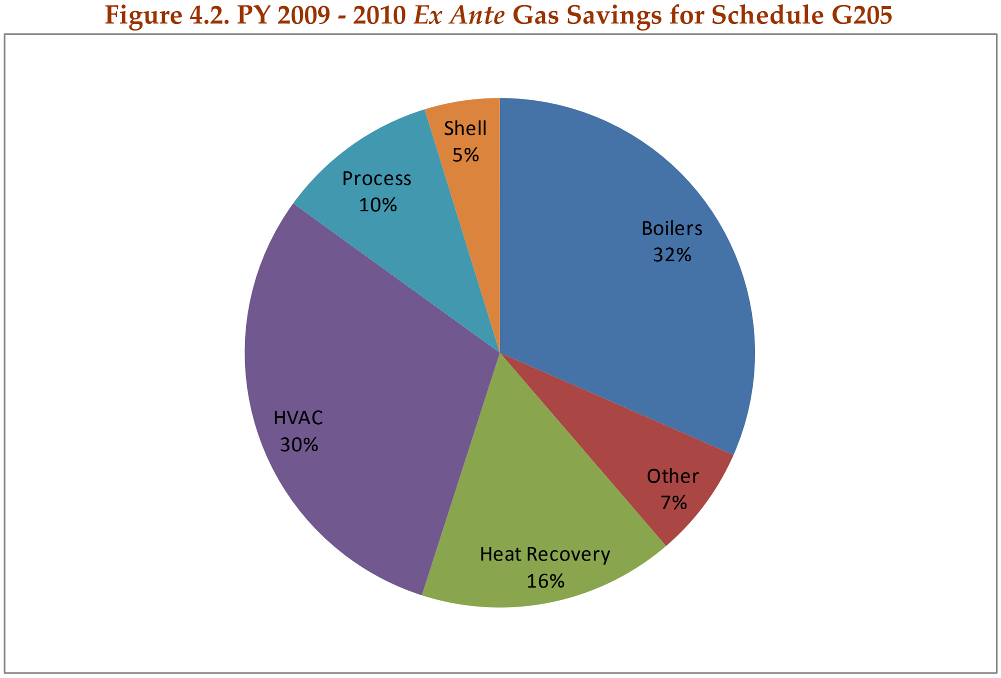


Figure 4.2. PY 2009 - 2010 *Ex Ante* Gas Savings for Schedule G205



4.1.2 Project File Reviews

Navigant's in-depth review of PSE's project files allowed Navigant to verify the accuracy of input assumptions and calculated savings; thereby ensuring that they were representative of installation conditions and consistent with industry standards. Navigant leveraged the measure prioritization hierarchy previously developed in which measures assigned to a higher "Tier" received a commensurate level of review effort.

The review of PSE's project files also allowed Navigant to prioritize on-site M&V metrics based on potential data gaps or inconsistencies within project-specific records. For example, Navigant remained cognizant of opportunities for bias in the data set, either because some customers were not included or because there was an absence of eligibility data for a particular group of participants. Navigant also reviewed the reasonableness of each parameter's *range* by assessing the variability/uncertainty between PSE's input assumptions and secondary studies. This type of sensitivity analysis was crucial in prioritizing and aligning task resources. Understanding the available data, and problems within each unique project file, allowed the evaluation team to make informed recommendations for future program cycles and custom calculation revisions.

Examples of secondary industry literature included through this review are listed below:

» Commercial and Institutional Building Energy Use Survey (CIBEUS).[95]

» Database for Energy Efficient Resources (DEER).[96]

» Buildings Energy Data Book (BEDB).[97]

» Commercial Buildings Energy Consumption Survey (CBECS).[98]

Navigant provided the full compendium of project files reviews to PSE prior to calculating Program Schedule-, Program-, and measure-level realization rates.

4.1.3 Impact Evaluation Sampling Framework

Navigant developed a sampling framework that provided a reasonable level of statistical accuracy, maximized the use of integrated surveys that effectively address Impact Evaluation objectives, and minimized evaluation expenditures. Furthermore, feedback from PSE staff ensured that the final sample design was consistent with both industry[99] and PSE's internal standards of statistical veracity.

For this evaluation, Navigant adopted a *Ratio Estimation* approach to sampling which achieves increased precision and reliability by taking advantage of a relatively stable correlation between an auxiliary variable and the variable of interest (i.e., the ratio of actual savings to program reported savings). This approach served to reduce the overall coefficient of variation within the population.

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[95] Demand Policy and Analysis Division of the Office of Energy Efficiency, Commercial and Institutional Building Energy Use Detailed Statistical Report, December 2002

[96] California Public Utilities Commission, Database for Energy Efficient Resources, 2008

[97] U.S. Department of Energy, 2008 Buildings Energy Data Book, 2008

[98] Energy Information Administration, Commercial Buildings Energy Consumption Survey, 2003

[99] TecMarket Works Team California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals, April 2006

As an example, consider a custom rebate program for business customers where project savings may range from 5 kW to 5,000 kW based on the size of each participating facility. Both the average size and the average savings for this group of customers will have very large coefficients of variation, thereby increasing the sample size required to achieve a specific confidence/precision threshold if the evaluation aims to estimate the *magnitude* of program savings.

However, evaluation experience has demonstrated that a majority of customers will have a ratio of actual savings to program reported savings between 70 – 100 percent, regardless of the *magnitude* of each individual project's energy savings. This ratio is the *realization rate* for gross verified savings and a core objective of this Impact Evaluation. As such, the standard deviation of the realization rate is generally much smaller than that of the magnitude of individual project savings. It follows that the sample sizes required to achieve a specific confidence/precision threshold may be greatly improved by estimating the realization rate instead of total energy savings.

Per the 2004 California Evaluation Framework[100], sample sizes developed using the Stratified Ratio Estimation approach complied with the following equation:

$$n = \frac{\left(\frac{Z * \varepsilon}{rp}\right)^2}{1 + \left(\frac{Z * \varepsilon}{rp}\right)^2 / N}$$

Where:

n = Sample Size
Z = Z-Score for Desired Confidence Level
ε = Assumed Error Ratio (0.4 Based on Prior Evaluation Studies)
rp = Desired Relative Precision
N = Population Size

Navigant proportionately stratified the sample by program reported savings. Under this approach, the sample population was divided into subgroups (i.e., strata) and sample units were chosen equal to the portion of the population in the strata. This strategy ensured that the largest contributors to program performance were evaluated, while also addressing a sufficient number of smaller projects that may inform future program design efforts (e.g., are there other savings opportunities at the smaller sites?).

The final sample developed in Table 4-10 below, achieved 90/10 confidence and precision by:

- Electric (Schedules 250 & 258) and Gas (G205) Program Schedules.
- Aggregated 2009-2010 Program Years.

[100] TecMarket Works, The California Evaluation Framework, June 2004

Table 4-10. Final Impact Evaluation Sample Sizes[101]

Confidence/ Margin of Error (%)	Schedules 250 and 258	Schedule 205	Total Sample Size
90/10	42	37	79

Navigant found that combining program years was appropriate under the assumption that within the populations for each year, the mean realization rate and variance around this mean was the same across years and programs that offered similar technologies. Throughout the course of the Impact Evaluation activities, Navigant continued to examine the validity of this assumption and found no biases with this approach.

PSE also expressed an interest in maximizing the confidence and precision of realization rate estimates for key measures of interest identified through the measure prioritization task; recognizing that the expected total sample size would remain the same.

[101] Due to relatively narrow scope of Schedule E257's tariff, coupled with its modest contribution to the aggregated MWh savings across PSE's three electric C&I Program Schedules being evaluated, evaluation activities for this Schedule were limited to a secondary literature review.

Table 4-11 and Table 4-12 provide sample size estimates around various measure-level confidence/precision intervals considered during the Impact Evaluation sample design process. The highlighted cells correspond to the confidence and precision thresholds ultimately achieved across these technologies while the overall Program Schedule sample size remained constant.

Table 4-11. Sample Sizes for Electric Measures of Interest

Confidence/ Margin of Error (%)	Lighting* (1057 Projects)	Refrigeration (826 Projects)	HVAC (192 Projects)	Process (120 Projects)	Total for Measures of Interest
80/10	7	25	23	22	77
80/15	3	12	11	11	37
80/20	2	7	6	6	21
90/5	42	143	91	71	347
90/10	11	41	35	32	119
90/15	5	19	17	17	58
90/20	3	11	10	10	34

*Values for a standard deviation of 20%.

Table 4-12. Sample Sizes for Gas Measures of Interest

Confidence/ Margin of Error (%)	Boilers (71 Projects)	HVAC (100 Projects)	Process (20 Projects)	Total for Measures of Interest
80/10	20	21	11	52
80/15	10	10	7	27
80/20	6	6	5	17
90/5	53	63	18	134
90/10	28	30	14	72
90/15	15	16	10	41
90/20	9	10	7	26

Table 4-13 provides a summary of the *Final Sampling Frame* for Electric and Gas projects slated to receive on-site M&V evaluation activities. Per PSE's feedback, Navigant developed the sampling framework to achieve 90/10 confidence and precision across lighting technologies, 80/20 across the remaining electric technologies, and 80/15 across the gas technologies offered through Schedule G205.

Table 4-13. Final Sample Sizes for On-Site M&V

Category	Lighting	HVAC	Boilers	Process	Refrigeration	Other	Total Sample Size
Electric	11*	8	N/A	8	9	6	42
Gas		10	10	7	N/A	10	37
Total	11	18	10	15	9	16	79

*Value for an assumed error ratio of 20% and 90/10 confidence/precision

Table 4-14 and Table 4-15 provide additional context on the final Impact Evaluation samples by total Program Schedule population savings. The E250 & E258 Impact Evaluation sample reviewed nearly 10% of total claimed savings while the G205 Impact Evaluation sample reviewed approximately 60% of total claimed savings. Furthermore, Navigant was able to achieve fairly good penetration within each measure category (e.g., 55% of boiler population savings verified) by ensuring that the largest projects were appropriately stratified and included within the evaluation samples. Conversely, measure categories with lower penetration values (e.g., 3% of lighting population savings verified) generally had more consistent savings claimed across all projects.

Table 4-14. Distribution of E250 & E258 Final Impact Evaluation Sample by Total Program Schedule Savings

Measure Category	IPMVP Strategy	Projects in Program Population	Program Population Savings (kWh)	Projects in Evaluation Sample	Sample Savings	% of Population Savings Verified
Lighting	B	974	69,653,719	11	2,075,117	3%
HVAC Measures	B/C	187	17,080,822	8	2,288,724	13%
Process Modification	B/C	35	10,313,628	8	6,044,070	59%
Refrigeration	B	288	15,699,942	9	3,456,050	22%
Other	B/C	786	39,499,005	6	1,116,077	2%
Total		***2,270***	***152,247,116***	***42***	***14,980,038***	***10%***

Table 4-15. Distribution of G205 Final Impact Evaluation Sample by Total Program Schedule Savings

Measure Category	IPMVP Strategy	Projects in Program Population	Program Population Savings (kWh)	Projects in Evaluation Sample	Sample Savings	% of Population Savings Verified
Boilers	B/C	77	48,756	10	247,971	55%
HVAC Measures	B/C	97	384,414	10	209,133	54%
Process Modification	B/C	20	146,205	7	120,527	82%
Other	B/C	82	445,097	10	266,513	60%
Total		***276***	***1,424,472***	***37***	***844,144***	***59%***

4.1.4 On-Site Measurement & Verification Analysis

In light of both the time and resources required for on-site data collection, Navigant recognized the importance of limiting EM&V activities to project-specific areas where knowledge was most limited, data gaps were the greatest, and uncertainty the highest. For monitoring purposes, measures within the EM&V sampling framework were classified according to the following construct:

> "***If both*** the efficiency ***and*** the output of the technology were constant, the measure was deemed ***constant performance.***"
>
> "***If either*** the efficiency ***or*** the output of the technology was variable, the measure was deemed ***variable performance.***"

This construct *complemented* the IPMVP Options recommended through the measure prioritization process for each "Tier." Table 4-16 provides an overview of these IPMVP Options employed throughout the course of this study and their relationship to both *constant* and *variable* performance measures:

Table 4-16. IPMVP Options and their Corresponding Data Requirements

IPMVP M&V Option	Measure Performance Characteristics	Data Requirements
Option A: Engineering calculations using spot or short-term measurements, and/or historical data	Constant performance	Verified installation Nameplate or stipulated performance parameters Spot measurements Run-time hour measurements
Option B: Engineering calculations using metered data.	Constant or variable performance	Verified installation Nameplate or stipulated performance parameters End-use metered data
Option C: Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multivariate regression analysis.	Variable performance	Verified installation Utility metered or end-use metered data Engineering estimate of savings input to SAE model
Option D: Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering	Variable performance	Verified installation Spot measurements, run-time hour monitoring, and/or end-use metering to prepare inputs to models Utility billing records, end-use metering, or other indices to calibrate models

The corresponding data requirements for each IPMVP Option and measure performance characteristic informed the development of On-Site M&V Plans.[102] The intent of each measure-level On-Site M&V Plan was to clearly specify which parameters would be collected on-site, how that information would be collected, and which methods would be used to translate the collected data into *ex post* gross realization rates. Moreover, these plans also integrated findings / data collection priorities revealed through the project file review process. Each On-Site M&V Plan addressed the following metrics:

[102] See Appendix L for the full volume of On-Site M&V Plans

- Project Evaluation Goals & Objectives
- Pre-Installation Equipment & Operation
- As-Built Equipment & Operation
- Seasonal Variability in Schedule and Production
- Algorithms Used in the *Ex Ante* Savings Estimates
- Algorithms Used in the Evaluation
- Site Specific Parameters and Data Collection Methods
- Quality Assurance Procedures and Uncertainty
- EM&V Analysis

Additionally, the On-Site M&V Plans provided a clear rationale for selecting a specific data collection strategy for key project performance variables (e.g., operating hours, loading capacity, etc.). In additional to visual verification and discussions with facility management staff, data collection activities generally fell into the following categories:

- **Spot Measurements –** Spot measurements were the first and simplest level of on-site performance measurement and included one-time instantaneous measurements of technology, system, or environmental factors including temperature, volts, amperes, true power, power factor, light levels, etc. As a general guide, this data collection strategy was used to quantify single operating parameters that did not vary significantly over time or were intended to provide a snap-shot in time. Spot measurements were not appropriate for measures sensitive to seasonal and/or longer term effects, but could be used in conjunction with other data collection activities to inform evaluation analyses.
- **Run-Time Data Logging –** Run-time monitoring represented the second level of performance measurement and was used to record run-time profiles over a given time period. Run-time monitoring was particularly useful for estimating long-term energy consumption from short-term measurements, particularly for technologies which exhibited constant performance characteristics. For example, this method was used extensively for assessing the operating hours of lighting retrofits incented through PSE's C&I Program Schedules.
- **Interval Metering –** Interval metering represented the most rigorous (and resource intensive) level of on-site performance measurement and involved real-time monitoring of a project's energy usage over a specified time period. This typically involved recording true energy use or "proxy" values such as voltage and amperes from which energy use could be extrapolated. Navigant reserved interval metering for larger projects falling into the higher priority measure "*Tiers*" that were particularly sensitive to true power readings and exhibited variable performance characteristics dependent upon both the weather and fluctuating demand (e.g., NCI ID #104)

Table 4-17 presents a summary of these evaluation IPMVP designations for this study:

Table 4-17. IPMVP Options for Prioritization Tiers

Tier	Fuel	IPMVP Option
1	Electric	A/B/C
1	Gas	B/C
2	Electric	A
2	Gas	A

Table 4-18 and Table 4-19 provide additional fidelity on the IPMVP data collection strategies employed for Tier 1 Electric and Gas Measures:

Table 4-18. IPMVP Option Designations for Tier 1 Electric Measures.

Measure Name	Measure Category	IPMVP Option
Lighting	Lighting – Commercial	A
Lighting fixtures plus controls	Lighting – Commercial	B
Fluorescent luminaries	Lighting – Commercial	A
HVAC controls only	HVAC - Commercial and Industrial	B/C
Process Modification	Process, Commercial	B/C
Other Process - High Voltage Program	Process, Commercial	B/C
Energy mgmt. control system	HVAC - Commercial and Industrial	B/C

Table 4-19. IPMVP Option Designations for Tier 1 Gas Measures.

Measure Name	Measure Category	IPMVP Option
Boilers, hot water GAS	HVAC - Commercial and Industrial	B/C
Heat recovery systems GAS	Heat recovery, Commercial	B/C
Gas Energy mgmt. control system	HVAC - Commercial and Industrial	B/C
Boilers - steam GAS	HVAC - Commercial and Industrial	B/C
Water heater, other gas	Water Heating – Commercial	A/B/C

Table 4-20 and Table 4-21 provide additional fidelity on the IPMVP data collection options that were adopted for Tier 2 Electric and Gas Measures:

Table 4-20. IPMVP Option Designations for Tier 2 Electric Measures.

Measure Name	Measure Category	IPMVP Option
Phase 2 - ECM Motors	Refrigeration – Commercial	A
Phase 2 - Floating Head Pressure	Refrigeration – Commercial	A
Other process	Process, Commercial	A
Chiller	HVAC - Commercial and Industrial	A
Refrigeration	Refrigeration – Commercial	B/C
Fans, variable frequency drive	HVAC - Commercial and Industrial	C
Lighting - High Voltage Program	Lighting – Commercial	A/B
HVAC Central equipment	HVAC - Commercial and Industrial	B/C
Phase 3 – Cases	Refrigeration – Commercial	A
Lighting - controls only	Lighting – Commercial	B/C
Phase 2 - Floating Suction Pressure	Refrigeration – Commercial	A
Commissioning, electric - Final 50%	O&M	A
Industrial Plant Lighting	Lighting – Commercial	A
Pumps	Process, Commercial	B/C

Table 4-21. IPMVP Option Designations for Tier 2 Gas Measures.

Measure Name	Measure Category	IPMVP Option
HVAC Central equip – GAS	HVAC - Commercial and Industrial	B/C
HVAC controls only – GAS	HVAC - Commercial and Industrial	B/C
Gas Process Heating	Process, Commercial	B/C
Other Process – gas	Process, Commercial	B/C
Fans - gas, variable frequency drive	HVAC - Commercial and Industrial	B/C
Roof ceiling insulation GAS	Building Shell – Commercial	A
HVAC Unitary equip. GAS	HVAC - Commercial and Industrial	A
Commissioning GAS	O&M	A
Other GAS	Core Services – Commercial	A
Wall insulation GAS	Building Shell – Commercial	A
Gas Energy Recovery System	Energy Recovery	A

Upon collecting the necessary data from each project included in the Impact Evaluation sampling framework, Navigant addressed the following issues in order to accurately determine *gross program impacts and realization rates*:

- » Determined the pre-installation technology performance baseline.
- » Verified that the incented measures listed for projects in the evaluation sample were installed and operating as intended.
- » Verified the baseline and measure performance characteristics of the measures installed and revising or computing performance variables (e.g., operating hours) as needed.
- » Determined the energy saving (kWh & Therm) impacts of the incented measures installed.
- » Estimated the load shapes for the incented measures installed through the programs, including the coincidence of each incented measure with peak demand periods.
- » Estimated the long-term persistence of project/Program Schedule impacts. Navigant observed cases where less than 100% of the incented measures' impacts persisted over time due to customer removal, tenant or occupant changeover, and other changes.

Other technical issues associated with determining *gross program impacts* included assessing the quality of the data that was available to work with from the on-site M&V data collection strategy, and determining what data manipulation systems and supplemental analyses were required to produce reliable estimates of program impacts.

4.2 *Findings*

As noted earlier, Navigant adopted the Stratified Ratio Estimation sampling approach to achieve 90/10 confidence/precision for the evaluation of PSE's *Program Schedule-level* realization rates. Under this approach, Navigant divided the sample population into subgroups (i.e., strata) and selected sample units equal to the portion of the population in each strata. This strategy ensured that Navigant evaluated the largest contributors to program performance, while also addressing a sufficient number of smaller projects that, in aggregate, could represent a substantial percentage of *ex ante* savings.

PSE also expressed an interest in maximizing the confidence and precision of realization rate estimates for key *measures of interest* identified through the measure prioritization task; recognizing that the expected total sample size would remain the same. The final sampling framework achieved 90/10 confidence and precision across lighting technologies, 80/20 across the remaining electric technologies, and 80/15 across the gas technologies offered through Schedule G205.

The following subsections present the realization rates across each of these two categories, along with an additional interpretation of realization rates by *Program*.

4.2.1 Measure and Program Schedule Realization Rates (As Evaluated)

The following tables present the *ex post* gross savings and realization rates for each Measure included in the final sampling framework, along with the corresponding realization rate. It should be noted that in addition to achieving 90/10 confidence/precision at the program schedule level, verified savings at the measure technology level achieved 80/20 confidence/precision through the sampling framework. The remainder of this section presents realization rates for the following technologies, along with a description of any unique observations from the field that may explain outlier realization rates:

» Gas Boilers

» Electric HVAC Measure

» Gas HVAC Measures

» Lighting Measures

» Electric Process Measures

» Gas Process Measures

» Refrigeration Measures

» Other Electric Measures

» Other Gas Measures

Navigant verified all boiler projects within the Impact Evaluation sample on-site; this included the collection of nameplate data and available production logs from the facility. Where possible, Navigant also used a combustion analyzer to verify proper boiler operation and efficiency. Billing data was primarily used to estimate boiler gas usage and HVAC boiler operation was compared to local outdoor air temperature (OAT) and normalized to TMY3 (typical meteorological year) data for the nearest available weather station to adjust for any weather variations that could affect *ex post* gas consumption.

Table 4-22. *As Evaluated* Gas Boiler Measure Realization Rates

Navigant ID	*Ex Ante* Therm Savings	*Ex Post* Therm Savings	Therm Realization Rate
45	182,197	163,977	90%
46	2,011	3,255	162%
50	526	439	84%
53	7,327	8,573	117%
67	934	1,064	114%
68	4,272	3,806	89%
69	21,859	24,263	111%
71	21,572	23,298	108%
73	2,189	2,999	137%
75	5,084	5,084	100%
	247,971	***236,759***	***95%***

NCI ID #73 had internal sub-meter billing data which could not be used for a pre-project baseline because it was improperly calibrated. In these cases, where pre-installation data was not reliable, Navigant used the post-installation usage and rated boiler efficiencies to estimate baseline consumption and *ex post* savings. Other boiler projects sites had additional gas measures implemented in parallel with the boiler retrofit. In these cases, where it was not possible to disaggregate gas usage for the multiple measures, Navigant reviewed the *ex ante* calculations and used the relative savings estimates to allocate savings from the billing analysis across each project. Observations from the field confirmed that most boilers operated within the ex ante specifications with the exception of two boilers exhibiting incomplete combustion. Figure 4.3 provides an example of the relationship between OAT and monthly boiler gas usage.

Figure 4.3. Outside Air Temperature and Boiler Gas Usage

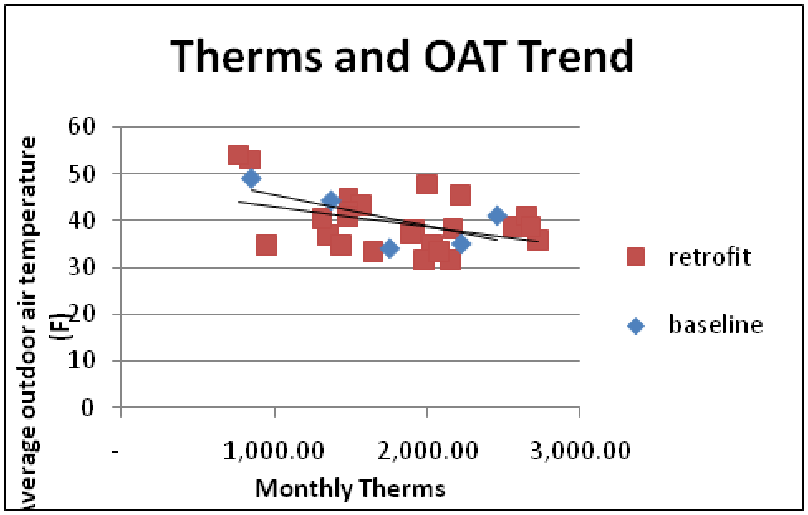


Table 4-23 and

Table 4-24 provide the realization rates for non-boiler HVAC measures. Chillers, air conditioners, furnaces, and HVAC controls fell into this classification. Due to the short time frame of the evaluation during a warming swing temperature season, heating measures received evaluation priority. Data collection for chiller projects was delayed by the unusually cold spring, and data collection for some heating measures was limited to low partial loads. Overall, baseline gas usage was modeled using long-term records of equipment operation from participating facilities.

Table 4-23. *As Evaluated* Electric HVAC Measure Realization Rates

Navigant ID	*Ex Ante* kWh Savings	*Ex Post* kWh Savings	kWh Realization Rate
1	516,361	588,652	114%
5	242,526	-	0%
9	638,135	620,905	97%
13	259,399	256,805	99%
15	256,312	492,119	192%
17	7,122	26,067	366%
25	16,462	39,344	239%
39	352,407	352,407	100%
Total	***2,288,724***	***2,376,299***	***104%***

It is worth mentioning that NCI ID #5 was unoccupied at the time of the evaluation, and the chillers were in standby. As a proxy, Navigant utilized the daily chiller logs from this site, coupled with facility billing records, to confirm savings. Although the chiller logs provided reliable trends, they only included chiller current draw and OAT. The lack of power factor information introduced increased uncertainty into the savings estimates; depending on the power factor assumption used, realization rates for this project ranged from 85% - 103%. A majority of the other projects shown in Table 4-23 provided Navigant with data from facility energy monitoring systems (EMS), which served as a third resource to triangulate verified savings.

Table 4-24. *As Evaluated* Gas HVAC Measure Realization Rates

Navigant ID	*Ex Ante* Therm Savings	*Ex Post* Therm Savings	Therm Realization Rate
48	40,047	36,042	90%
58	7,648	9,484	124%
60	84,628	80,904	96%
61	27,356	30,639	112%
63	152	512	337%
65	26,040	18,228	70%
77	1,424	926	65%
78	1,240	806	65%
79	4,218	5,399	128%
101	16,380	20,269	124%
Total	***209,133***	***203,209***	***97%***

Similar to their electric counterpart, gas HVAC measures were primarily evaluated through facility billing records, OAT, and TMY3 data from the nearest available weather station. When possible, spot measurements and end-use metering complemented the aforementioned data sources. NCI ID #48 installed multiple gas measures simultaneously and the *ex post* realization rate was calculated on the suite of measures installed since their individual impacts could not be disaggregated with the available data. And NCI ID #65 was mostly idle due to decreased occupancy/demand within the laboratory spaces where the incentivized fume hoods were installed. This phenomenon was largely driven by economic factors outside of PSE's program influence.

Figure 4.4 provides an example of the linear relationship between energy consumption and OAT for an electric HVAC project, while Figure 4.5 provides a graphical depiction of pre-/post-installation consumption for a gas HVAC project included in the Impact Evaluation sample.

Figure 4.4. Regression of Energy Usage over OAT

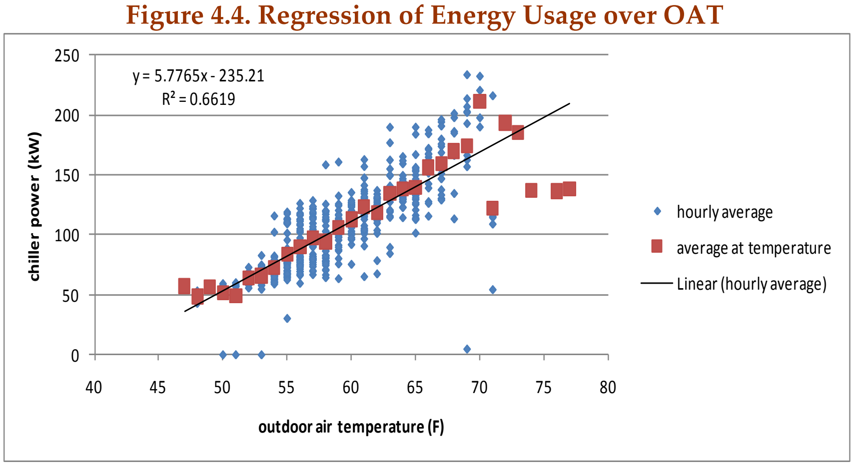
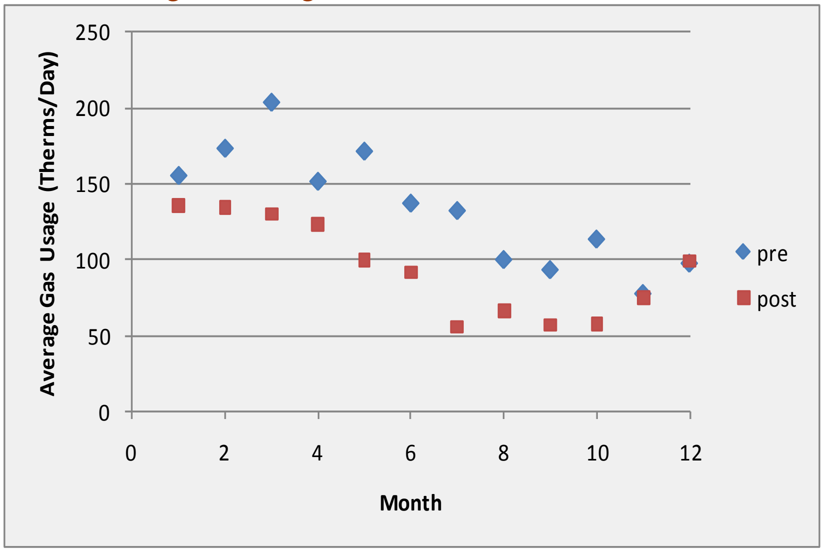


Figure 4.5. Average Gas Usage of HVAC Unit Pre-retrofit and Post-retrofit



All of the lighting projects included in the Impact Evaluation sample yielded realization rates greater than 90%. On-Site M&V activities focused on confirming measure presence/operation, on-off logging of representative spaces affected by lighting retrofits, and discussions with facility staff to contrast against metering findings.

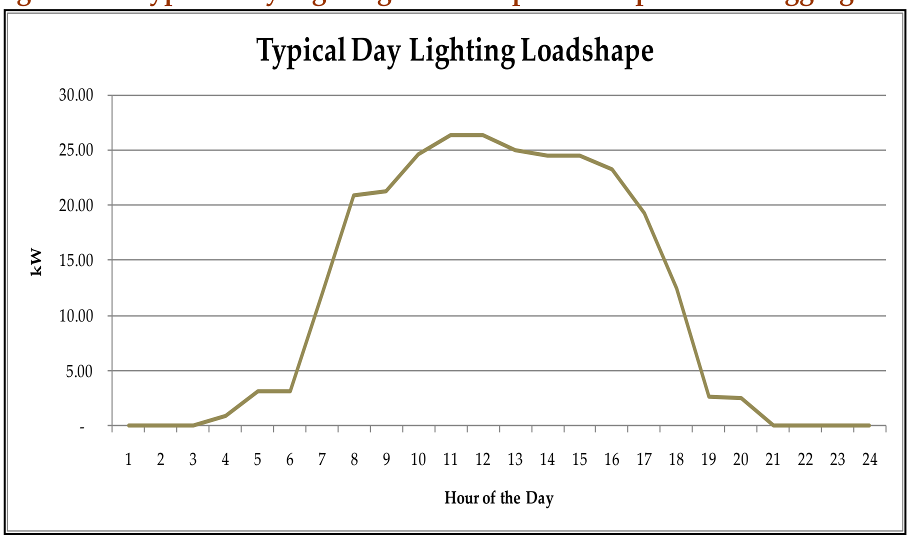
Table 4-25. ***As Evaluted*** **Lighting Measure Realization Rates**

Navigant ID	*Ex Ante* kWh Savings	*Ex Post* kWh Savings	kWh Realization Rate
6	108,726	104,377	96%
7	244,167	244,167	100%
10	344,643	344,643	100%
16	16,832	17,674	105%
19	55,492	55,492	100%
27	116,744	140,093	120%
28	112,492	157,489	140%
32	11,122	11,567	104%
35	103,464	101,395	98%
36	336,238	339,600	101%
40	625,197	625,197	100%
Total	***2,075,117***	***2,141,693***	***103%***

A key component of evaluating lighting projects within this study involved developed pre-/post-installation operating profiles (

Figure 4-6). Navigant extrapolated thee operating profiles to estimate annual hours of operation. Collectively, the annual operating hours were applied across the wattage savings attributed to the more efficient lighting technologies incented through the program to develop *ex post* savings estimates.

Figure 4.6. Typical Day Lighting Load Shape Developed from Logging Data



Process measures included air compressor retrofits, data center modifications, pump and fan VFDs, process equipment, and control modifications. Compressed air measures and data center modifications contributed the largest portion of electric savings in this category. The realization rate of electric process measures was generally greater than 90%.

Gas process measures included a variety of custom gas process efficiency measures such as process equipment for drying, fume hood ventilation, glass blowing, and cooking, as well as a greenhouse improvement measure.

Table 4-26. *As Evaluated* Electric Process Measure Realization Rates

Navigant ID	*Ex Ante* kWh Savings	*Ex Post* kWh Savings	kWh Realization Rate
2	199,360	189,392	95%
4	78,151	77,213	99%
8	18,553	19,295	104%
14	1,087,566	1,457,338	134%
21	368,886	365,197	99%
38	2,028,130	2,616,288	129%
41	1,069,786	1,133,973	106%
42	1,193,638	1,611,411	135%
Total	***6,044,070***	***7,470,108***	***124%***

Two data center projects (NCI ID#14 and NCI ID #42) included improvements to their respective cooling and airflow systems to reduce the energy required to maintain appropriate server temperatures. A combination of metered data, facility logs, and historical billing records were used to evaluate, and confirm, the savings for these projects. Navigant ID #38 implemented controls on their compressed air system, which enabled the detailed monitoring of system operating characteristics. The facility found that these data allowed them to decrease the air pressure in the system beyond what they had originally expected, resulting in increased savings above *ex ante* estimates.

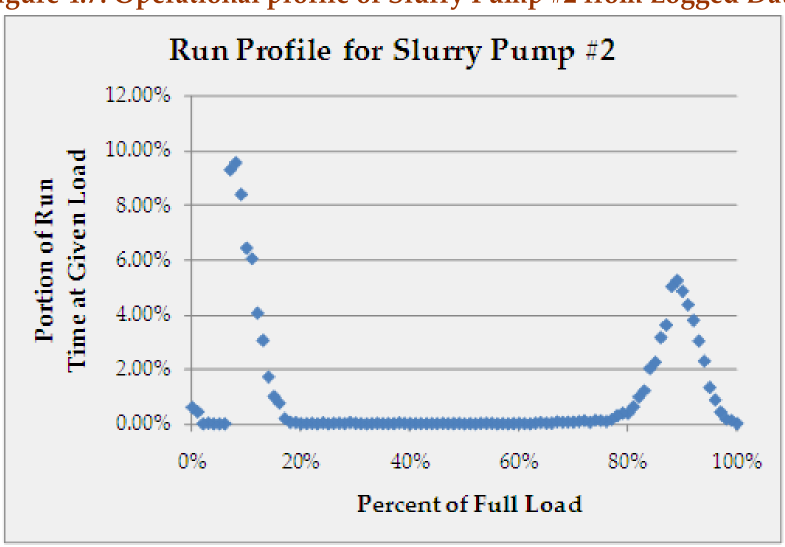
Table 4-27. *As Evaluated* Gas Process Measure Realization Rates

Navigant ID	*Ex Ante* Therm Savings	*Ex Post* Therm Savings	Therm Realization Rate
49	8,934	10,176	114%
51	7,958	6,446	81%
52	708	-	0%
55	1,576	1,434	91%
66	9,659	6,761	70%
70	86,420	47,531	55%
74	5,272	6,326	120%
Total	***120,527***	***78,675***	***65%***

Navigant utilized facility billing records as the primary tool for evaluating gas process improvement savings. And while all gas process measures in the Impact Evaluation sample received on-site verifications, production schedules heavily influenced equipment operation and, by association, realized savings. In these cases, Navigant normalized energy consumption against historical production data to ensure the baseline schedules were uniform in both the *ex ante* and *ex post* analyses. Similarly, most electric process improvement equipment, such as the slurry pump installed at NCI ID #41 (Figure 4.7), received run-time logging coupled with a review of trend data from the participating facility's EMS system to evaluate *ex post* savings.

NCI ID #52 claimed to install an automatically controlled "energy curtain." However, engineers on-site observed a manually operated shade cloth that was only used April through October. For two of the past four years, three of these summer months have shown zero gas use, resulting in 0 Therm savings.

Figure 4.7. Operational profile of Slurry Pump #2 from Logged Data



Of the 13 refrigeration projects verified on-site, 12 projects were implemented through PSE's Energy Smart Grocer (ESG) program. However, the single project that was not part of the ESG program, NCI ID #104, comprised 77% of the sampled *ex ante* energy savings under the refrigeration category. Additionally, floating head pressure and/or floating suction controls, including those installed at NCI ID #104, accounted for 97% of the *ex ante* energy savings under the refrigeration category and were deemed a measure of interest by PSE.

As refrigeration compressor racks were typically custom built, Navigant procured refrigeration measure performance data using a combination of end-use metering and available trend data. Either the power or the current draw of the refrigeration rack was logged depending on whether the compressor operation was staged or had variable speed drives. Compressor energy usage was compared to OAT and normalized to TMY3 data for the nearest available weather station. M&V occurred during low production; therefore, some refrigeration control strategies could not be directly verified during operating hours.

Table 4-28. *As Installed* Refrigeration Measure Realization Rates

Navigant ID	*Ex Ante* kWh Savings	*Ex Post* kWh Savings	kWh Realization Rate
11	6,520	6,520	100%
12	1,865	1,865	100%
18	81,672	23,685	29%
26	130,656	173,772	133%
29	80,737	-	0%
30	68,508	70,974	104%
31	10,193	10,193	100%
34	109,555	111,746	102%
37	138,674	140,061	101%
104	2,827,670	2,047,233	72%
Total	***3,456,050***	***2,586,050***	***75%***

NCI ID #104, the only refrigeration project in the evaluation sample outside of the ESG program, provided Navigant with detailed facility trends that were used to evaluate savings at the site. It is worth noting that a tenant, for whom operational details were not available, occupied a portion of the facility. Although this introduced increased uncertainty into the savings estimates, the facility trend data permitted the analysis to provide a reasonably reliable estimate of savings for the site.

NCI ID #29 was closed due to the economic downturn and realized 0% of the project claimed savings. However, Navigant calculated *Economically Adjusted* realization rates for these measures and provides the rationale for their savings in *Section 4.3 Factors Influencing Evaluation Realization Rates*.

Measures that did not fall into the lighting, HVAC, boilers, refrigeration, or process categories were categorized as "Other Technologies." These measures included heat recovery systems, insulation and shell measures, and pool covers. Several sites installed multiple measures with interactive effects; NCI ID #57 and NCI ID #59 installed heat recovery systems along with pool covers. In such cases, Navigant did not attempt to disaggregate the savings for each project in order to properly account for potential interactive effects at the facility.

In general, Navigant identified the measures installed and logged or obtained facility monitoring data for most electrical systems in this category. Conversely, billing data served as the primary tool for the evaluation of all gas technologies in this technology. Overall, the realization rates of *other* gas projects were very high while the realization rates of *other* electric projects exhibited more variability due to the unique applications in which the measures were installed.

Table 4-29. *As Evaluated* Other Electric Measure Realization Rates

Navigant ID	*Ex Ante* kWh Savings	*Ex Post* kWh Savings	kWh Realization Rate
20	263,703	263,703	100%
22	467,607	448,435	96%
24	129,215	152,086	118%
33	9,158	8,215	90%
43	206,394	63,982	31%
83	40,000	23,600	59%
Total	***1,116,077***	***960,821***	***86%***

As an example, NCI ID#43 had an exceptionally low realization rate because it was the secondary pump at the project site and the initial estimate of operational hours was significantly higher than indicated by the facility logs three months prior to the evaluation, along with discussions with facility personnel.[103] NCI ID #22 and NCI ID #24 also provided Navigant with a robust set of trend data from facility monitoring systems which were leveraged to evaluate savings for the two replacement chillers.

[103] It should be noted that the second pump retrofit (not included in the Impact Evaluation sample) achieved a realization rate of 111%. The total realization rate for the two pump retrofits at the facility was 74%.

Table 4-30. *As Evaluated* Other Gas Measure Realization Rates

Navigant ID	*Ex Ante* Therm Savings	*Ex Post* Therm Savings	Therm Realization Rate
44	1,148	3,685	321%
47	30,636	27,572	90%
54	10,716	12,538	117%
56	707	778	110%
57	62,484	76,230	122%
59	34,149	34,149	100%
62	111,058	111,058	100%
64	444	417	94%
76	13,552	12,739	94%
80	1,619	1,991	123%
Total	***266,513***	***281,158***	***105%***

The realization rate for NCI ID #47 accounted for the interactive effects among four projects installed in parallel at the site. In this case, savings were combined across all projects because the individual measure savings could not be disaggregated using the available data.
Table 4-31 and
Table 4-32 provide a summary of measure-level realization rates for both electric and gas technologies. Overall, PSE's C&I portfolio has achieved realization rates that reflect the accuracy of *ex ante* savings estimates. The lower than average realization rates for Refrigeration (75%) and Other Electric Measures (86%) were primarily attributed to a reduction in production throughput due to the economic downturn. We discuss methods for separating the non-programmatic economic impacts from the calculated realization rates in *Section 4.3 Factors Influencing Evaluation Realization Rates.*

Table 4-31. Summary of *As Evaluated* Realization Rates by Measure Category for Program Schedules E250 & E258

Measure Category	Projects in Evaluation Sample	*Ex Ante* Savings	*Ex Post* Savings	Realization Rate
Lighting	11	2,075,117	2,141,693	103%
HVAC Measures	8	2,288,724	2,376,299	104%
Process Modification	8	6,044,070	7,470,108	124%
Refrigeration	9	3,456,050	2,586,050	75%
Other	6	1,116,077	960,821	86%
Total	***42***	***14,980,038***	***15,534,971***	***104%***

Table 4-32. Summary of *As Evaluated* Realization Rates by Measure Category for Program Schedule G205

Measure Category	Projects in Evaluation Sample	*Ex Ante* Savings	*Ex Post* Savings	Realization Rate
Boilers	10	247,971	236,759	95%
HVAC Measures	10	209,133	203,209	97%
Process Modification	7	120,527	78,675	65%
Other	10	266,513	281,158	105%
Total	***37***	***844,144***	***799,801***	***95%***

As previously noted, the Impact Evaluation Framework achieved 80/20 confidence/precision at the measure technology level. Conversely, the Impact Evaluation Framework achieved 90/10 confidence/precision at the *Program Schedule* level. This was accomplished by first calculating *case weights* for each evaluated project; the case weight is simply the number of projects in the population in each stratum divided by the number of projects in the final sample in the corresponding stratum.[104]

The program level realization rate was then calculated as the ratio between the product of case weights and *verified* savings estimates and the product of case weights and *reported* savings estimates. This process is illustrated by the equation below:

$$Program\ Realization\ Rate_i = \frac{\sum_{i=1}^{n} Case\ Weight_i\ \times\ Verified\ Savings\ Estimate_i}{\sum_{i=1}^{n} Case\ Weight_i\ \times\ Reported\ Savings\ Estimate_i}$$

Table 4-33 provides the final *As Evaluated* Realization Rates for PSE's C&I Program Schedules.

Table 4-33. Summary of *As Evaluated* Program Schedule Realization Rates (PY 2009 – 2010)

Program Schedule	Program Spending	Ex Ante Savings	Ex Post Savings	Realization Rate
E250 & E258	$39,954,232	152,247 MWh	155,749 MWh	102.3%
G205	$3,864,784	1,424,472 Therms	1,428,745 Therms	100.3%

[104] The TecMarket Works Team, The California Evaluation Framework, Prepared for the California Public Utilities Commission and the Project Advisory Group, June 2004

4.3 *Factors Influencing Program Schedule Realization Rates*

As noted earlier, the project-/program-level realization rates provided in the previous section reflect the difference between expected savings at the time of installation and verified savings more than one year after project completion. Navigant observed that many participants altered their operating profiles between this timeframe for a myriad of reasons outside the realm of program influence, including:

» **Idiosyncratic Factors** – changes in equipment usage and operating patterns that are unique to a participant's financial health, employee attrition, and corresponding production schedules.

» **Economic Factors** – changes in equipment usage and operating patterns as a result of shifts in industry and economic climates.

The following sections explore each of the non-programmatic factors and while quantifying their impact on project-/program-level realization rates. Navigant distinguished the impacts from each of these factors through ongoing discussions with facility personnel during the evaluation process.

4.3.1 Idiosyncratic Factors (As Installed Realization Rates)

Out of necessity, the merits of energy efficiency projects must be judged by the best information available, which is usually operating practices observed at the time of evaluation. Navigant recognized, however, that operations observed during the M&V process may differ significantly from the planning and/or installation conditions. When energy efficiency measures are climate dependent the process for weather normalization is well-established, whether by simulation, typical meteorological year data, or degree days. However, when other *idiosyncratic* factors affect operations (e.g., attrition, unforeseen operating and maintenance requirements, etc.), the normalization process is less clear.

As a proxy, Navigant carefully reviewed the documentation on evaluated projects and compared the pre-installation assumptions used to develop *ex ante* savings estimates to the *ex post* observations and feedback from facility personnel. In addition to the project input assumptions, Navigant also reviewed the *ex ante* calculation methodologies against industry standards and accepted engineering practices. Finally, Navigant collaborated with PSE to ensure that all available information collected during the participation process was properly accounted for in the *ex post* savings analyses.

Collectively, Navigant used this information to reconstruct the project planning/pre-installation conditions along with the corresponding savings realized upon project completion (*As Installed Realization Rate)*. The realization rate metric at this particular point in the program cycle is a significant milestone and of key interest from a stakeholder perspective which warranted this additional level of investigation.

Table 4-34. Summary of *As Installed* Program Schedule Realization Rates

Program Schedule	Program Spending	Ex Ante Savings	Ex Post Savings	Realization Rate
E250 & E258	$39,954,232	152,247 MWh	151,181 MWh	99.3%
G205	$3,864,784	1,424,472 Therms	1,423,047 Therms	99.9%

It is important to note that the realization rates provided in Table 4-34 are conservative; the realization rate at the point of installation is an instantaneous metric that cannot account for variability in weather patterns and productions schedules which inevitably drive project performance over time. As such, the *As Installed* realization rates only capture overestimates in the *ex ante* savings methodologies, of which PSE's C&I Program Schedules had limited instances of:

» NCI ID #26: The *ex ante* analysis leveraged Regional Technical Forum (RTF) values to calculate refrigeration project savings. Navigant accepted this analysis and assigned an *As Installed* realization rate of 100% to this project. However, the *As Evaluated* realization rate was calculated to be 133%; similar to the realization rates found from a BPA impact study of the Energy Smart Grocer Program from several years ago. In this case, the *As Installed* realization rate was lower than what was actually achieved.

» NCI ID #18: This project involved the installation of refrigerator strip curtains. However, the HVAC system was more efficient than assumed in the *ex ante* analysis resulting in an *As Installed* realization rate of 61%. PSE subsequently removed this project from its claimed savings due to lack of proper documentation. The project was netted to 0 savings by creating a project 085-0263 claiming a -81,672 kWh savings.

» NCI ID #43: This project involved two pump retrofits at one facility, only one retrofit of which was evaluated. Discussions with facility personnel revealed an overestimate in pump operating hours resulting in an *As Installed* realization rate of 31%. However, the second pump retrofit (not included in the Impact Evaluation sample), achieved a 111% realization rate, resulting in a 71% realization rate for the facility

» NCI ID # 64: This project involved the installation of insulation at a participant facility. The *As Evaluated* realization rate was 94% due to the addition of ceiling fans which were not present at the time of installation. Through discussions with PSE, Navigant recognized that in some cases, ceiling fans actually increase convective heat loss through the roof. In the absence of the ceiling fans, the *As Installed* realization rate was actually 100%.

» NCI ID #83: This project involved the installation of a retrofit compressor. Navigant noted a calculation error in the VFD compressor power calculation which reduced the *As Installed* realization rate to 59%

More importantly, the *As Installed* realization rates provide insight into the accuracy of the calculations used to forecast savings in the absence of post-installation data. And the results of this effort clearly indicate that PSE's EME's are correctly applying mathematically astute methods to the *ex ante* analyses. This finding is reflective of the high realization rates for PSE's C&I Program Schedules across both program years evaluated. For a majority of the projects evaluated, deviations between the *ex ante* and *ex post* savings estimates were explainable through idiosyncratic factors, economic factors (discussed further, in the following subsection), and by the inherent variability surrounding measure performance (e.g., occupancy sensors).

4.3.2 Economic Factors (Economically Adjusted Realization Rates)

The C&I sector is particularly sensitive to economic changes because production throughput, occupancy, and operating schedules are driven by customer demand. Similarly, the changes in equipment usage also affect the efficiency of the baseline and replacement technologies incented through PSE's Program Schedules. Throughout the Impact Evaluation, Navigant encountered a number of participant sites affected by these *economic* factors; a majority of which realized lower than expected *ex post* savings estimates. Examples of the economic factors affecting program realization rates, included:

» **Change in Production Schedules**

- NCI ID #21: This project involved the installation of compressor upgrades at a manufacturing site. Although the *As Evaluated* realization rate was 99%, the facility actually increased their production requirements by consolidating all production into one line as a result of the economic downturn. This increased the load on the compressor, resulting in lower savings. The *Economically Adjusted* realization rate for this project was 109%.

» **Idled Equipment (Temporary Shutdown):**

- NCI ID #65 and NCI ID #66: This project installed fume hood retrofits at a participant lab. As a result of the economic recession, a majority of the fume hoods are now idle with future occupancy (and usage) expectations. The *As Evaluated* realization rates were 70%, but the *As Installed* and *Economically Adjusted* realization rates were both 100%.
- NCI ID #5: This project involved the chiller upgrades at a large facility. As a result of the economic downturn, the facility has since closed but is expected to re-open. And though the *As Evaluated* realization rate is 0%, both the *As Installed* and *Economically Adjusted* realization rates are 100%.

» **Site Closure (Permanent Shutdown):**

- NCI ID #29: This facility installed refrigeration upgrades but as a result of the economic downturn, is permanently closed. Even though the *As Evaluated* realization rate was 0%, Navigant confirmed that the *As Installed* and *Economically Adjusted* realization rates were 100%.

The subsequent impact of these economic-driven changes on project-/program-level realization rates compound over time because savings estimates apply across a measure lifetime of several years. As such, Navigant recognized the importance of disaggregating the effects of these factors when assessing program performance and developed a robust method that accounted for variations in operating conditions attributed to external economic activity.

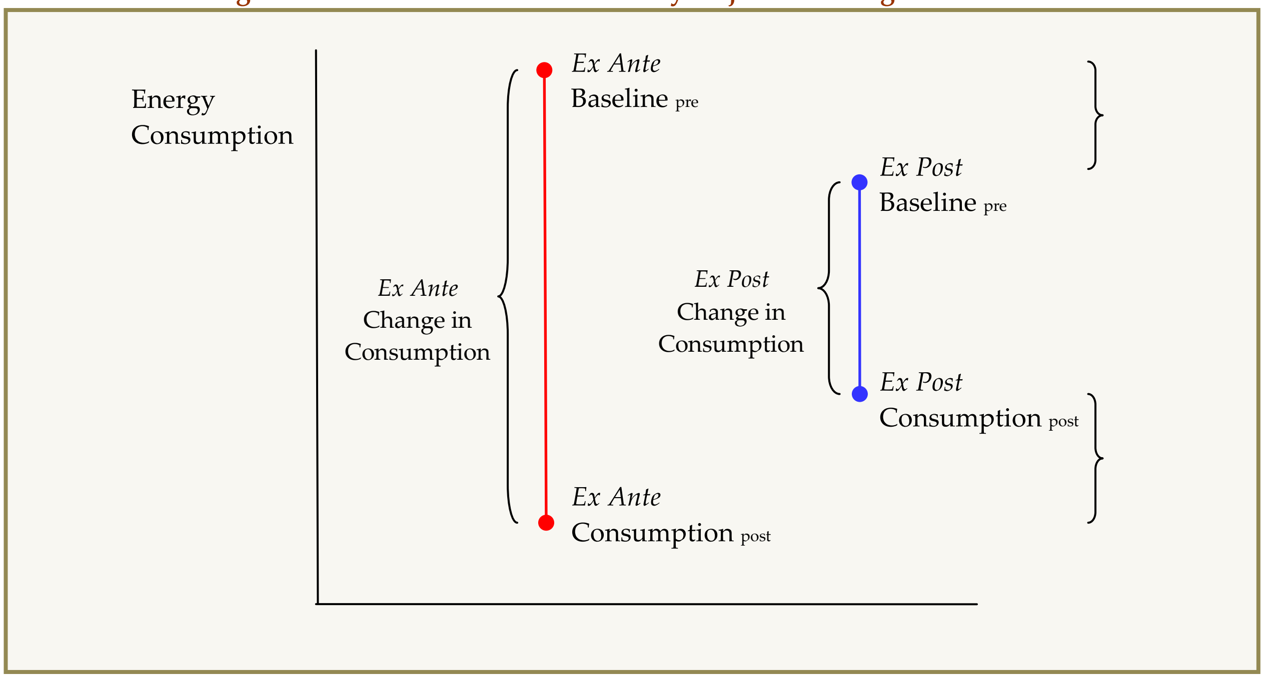
For temporary changes in the participant production schedule, Navigant calculated savings using two consistent baselines:

4.) *Full Production (Ex Ante) Baseline Operating Schedule:* Both pre- and post-installation energy consumption was calculated using the production schedule observed at the time of participation (i.e., full production schedule). Full-production adjusted operating schedules were derived from a comprehensive review of historic production logs relative to current operating schedules.

5.) *Current Production (Ex Post) Baseline Operating Schedule:* Both pre- and post-installation energy consumption was calculated using the production schedule during the on-site M&V process (i.e., current production schedule).

Figure 4.8 provides a graphical representation of the savings estimates for each baseline condition; the difference of which distinguished savings attributed to the economic downturn. This approach discounted production schedule changes associated with demand-driven capacity requirements.

Figure 4.8. Illustration of Economically Adjusted Savings Estimates



With the recent downturn, many businesses experienced temporarily idled production areas, but still planned on recovering this excess capacity when business conditions improved. Navigant's approach to normalizing realization rates for the current and full production operating schedules ensured a more representative perspective on long-term program savings potential. Conversely, once a site or process was completely shut down (e.g., sold or reconfigured), savings were deemed irrecoverable.

It should be noted that while the recession generally reduced realized savings, there existed opportunities for *increased* energy savings in specific applications. The part-load efficiency of variable speed compressors, for example, are much more efficient than their single-speed counterparts. Figure 4.9 illustrates the different operating modes and relative efficiency of a rotary screw compressor with different capacity modulation. Assuming a compressor upgrade is incented, a PSE project may have operated two shifts in the region labeled "A" with approximately 10% full load power savings over a baseline machine with slide-valve modulation. The remainder of the time the compressor would operate in region "C" with savings of approximately 50% full load power. However, under a reduced production schedule, the facility may no longer operate in the "A" region but instead save 25% of full-load power in the "B" region during approximately 1.5 shifts of plant operation and spend more time unloaded (50% of full load savings versus the baseline machine) in the absence of demand for compressed air. Though these situations do arise, the upside in savings potential is often overshadowed by the overwhelming number of projects experiencing a decrease in realized savings.

Figure 4.9. Illustrative Compressor Performance at Key Operating Points

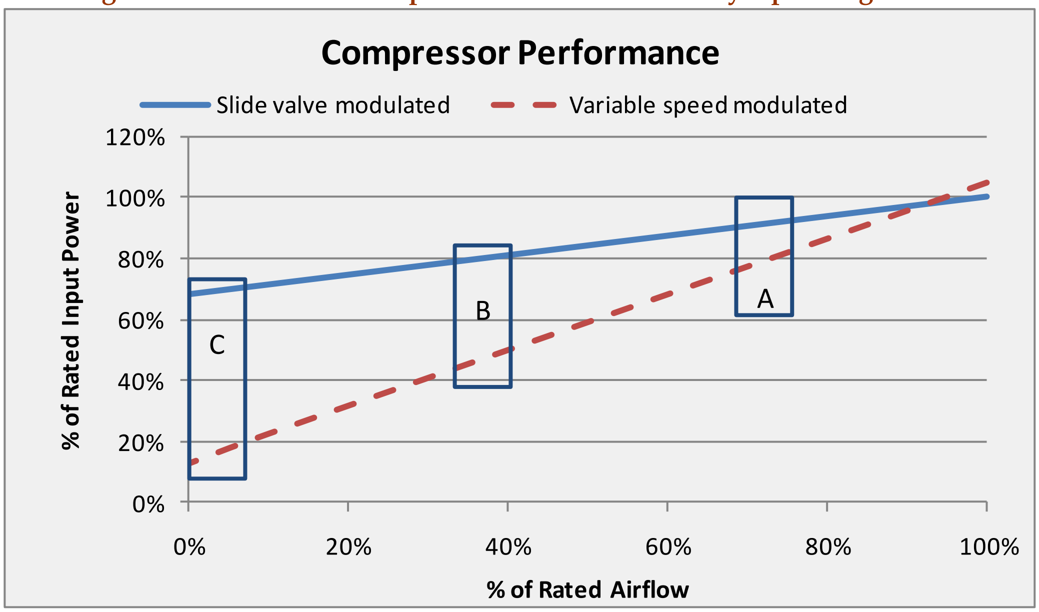


Table 4-35 provides a summary of economically adjusted Program Schedule realization rates. The findings reveal an increase in realization rates when excluding the effects of the *economic* factors, particularly for two sites that closed would have yielded a 100% realization rate.

Table 4-35. Summary of *Economically Adjusted* Program Schedule Realization Rates

Program Schedule	Program Spending	Ex Ante Savings	Ex Post Savings	Realization Rate
E250 & E258	$39,954,232	152,247 MWh	161,230 MWh	105.9%
G205	$3,864,784	1,424,472 Therms	1,428,745 Therms	102.4%

4.4 *Validity and Reliability of M&V Findings*

Navigant identified several sources of uncertainty associated with estimating the impacts of the PSE C&I Program Schedules. Examples of such sources include:

» Sample selection bias.

» Physical measurement bias (e.g., meter bias, sensor placement, non-random selection of equipment or circuits to monitor).

- » Engineering analysis error (e.g., baseline construction, engineering model bias, modeler bias).

Navigant remained cognizant of these issues throughout the evaluation process and adopted methods to reduce the uncertainty arising from these sources, thereby improving the validity and reliability of study findings. Key uncertainty sources and mitigation strategies are discussed further below.

4.4.1 Reducing Uncertainty from Sample Selection Bias

The problem that selection bias creates for program evaluation has been long recognized. Although projects were chosen in the impact evaluation sample according to prescribed protocols, bias may have been introduced if the selected projects did not choose to participate in the evaluation effort. In an effort to minimize non-response bias, Navigant established and implemented the following recruitment protocols:

- » Notified participants as early as possible in the evaluation process.
- » Accurately characterize M&V activities and the duration of the evaluation process.
- » Maintained brief and frequent communication with participants and inform them of any changes/additions to the evaluation effort.

The intent of these protocols was to give each participant ample time to prepare documentation and secure the appropriate resources to support the evaluation effort. Brief and frequent contact with each participant ensured the participant remained engaged.

In the event that a non-respondent was encountered, Navigant first identified the nature of the project (i.e., measure type). Non-response for non-certainty projects was addressed by oversampling projects within each of the original stratum. These "alternative" projects were substituted into the impact sample in the event that a project did not respond to evaluation requests. Non-response for certainty projects were generally addressed by choosing similar projects (i.e., measure technologies) with equivalent, or larger savings. Collectively, this effort ensured that precision levels were met within the overall impact evaluation sample.

4.4.2 Reducing Uncertainty from Physical Measurement Error

There is inevitably some error associated with all physical measurement. For the impact evaluation of PSE's C&I Program Schedules, a large measurement effort involved installing lighting/current/power loggers to determine the operating characteristics of baseline and retrofit technologies across a broad range of applications. Several steps were taken to minimize the uncertainty resulting from bias/error that may have been introduced in this process:

- » Prior evaluation experience indicates that lighting loggers sometimes fail in the field due to flickering or battery issues.[105] To account for the possibility that some of these loggers might fail in this evaluation, Navigant deployed backup loggers for each site. This ensured that the sample size requirements would be met even if a percentage of the loggers failed.

[105] Evaluation experience has found that 'typical' failure rates generally range between 5% – 10%.

- To minimize measurement error from improper calibration of the lighting/current/power loggers, Navigant checked all loggers used in the field to ensure that they were properly calibrated prior to being deployed. Field staff were also trained to use consistent measurement intervals whenever possible, and to synchronize the logger deployment activities (e.g., time delay). This ensured that the data could be compared across a uniform time period.
- To minimize biases arising because of improper placement of the loggers, field staff were given a prescribed protocol for the placement and installation of loggers on circuits (e.g., CT placement) and fixtures (e.g., uniform distance from the lamps).
- Usage patterns for retrofit measures may vary from month-to-month. Sampling for a short duration could therefore introduce a degree of error into the overall results. To reduce this type of error, loggers were typically deployed for a minimum of four weeks and supplemented with available facility records (e.g., EMS trends, production logs, etc.). The logged data was used to calibrate the facility records which spanned multiple months or years. These extended logging intervals minimized the bias introduced from extrapolating short term metering results to longer periods of time.
- Poor quality data can also be a significant source of error and uncertainty. To minimize the potential impact of this problem, various quality assurance checks were applied to the logger results. This included consistent spot measurements that could be compared against both the EMS and logger data. Additionally, qualified analysts reviewed all logger files to ensure that the results were representative of the technology being investigated:
    - Lighting loggers were reviewed to identify inconsistencies in operating characteristics and/or extended periods of inactivity. If a particular file was deemed suspicious, Navigant followed up with field staff and facility managers to ensure that the findings were reasonable. Inaccurate results were removed from the analysis.
    - Current/power loggers were reviewed to ensure that consumption was representative of the technology being investigated. Suspect operating characteristics were reviewed with field staff and facility managers to clarify usage pattern anomalies. As with the lighting loggers, inaccurate findings were removed from the analysis.

4.4.3 Reducing Uncertainty from Engineering Analysis Error

There are several opportunities for biases in engineering analyses that may compound the error and uncertainty of *ex post* savings estimates. Navigant adopted the following protocols to minimize uncertainty from engineering analysis error in this study:

- All project analysis findings were peer reviewed to ensure that consistent methods and assumptions were used throughout the Impact Evaluation
- Navigant developed data collection protocols that yielded appropriate inputs into the analysis models and reviewed all field observations with the evaluation team. Collectively, this served to reduce potential modeling error in this study.

4.4.4 Recommendations for Reducing Uncertainty in Future Evaluation Cycles

Most of the sources of bias and uncertainty discussed here are documented and well-researched. Moreover, the recommendations for addressing and/or minimizing these sources have proven successful in previous evaluation studies. However, equipment (e.g., logger) failure has not received a great deal of attention and may reduce the precision and confidence of evaluation findings. To compensate for the consistent nature of these failures, Navigant recommends developing future evaluation frameworks to identify failure rates by equipment type, and accounting for these failure rates when estimating the quantify of metering equipment needed to achieve confidence and precision level targets.

4.5 *Impact Evaluation Conclusions and Recommendations*

Navigant staff thoroughly documented the Impact Evaluation process in an effort to capture and assess program feedback based on discussions with participants, program data, auxiliary reports, and evaluation observations. This information has been used to develop recommendations that will improve future program and impact evaluation cycles.

Recommendation 1: Standardize Participant Data Requirements

The accuracy of impact evaluation findings is dependent upon the availability and quality of participant measure data. Although a majority of the projects included comprehensive participation data that allowed for the calculation of both *ex ante* and *ex post* energy savings, some projects had insufficient data within the project application to plan evaluation activities. Specifically, projects within the ESG Program were difficult to contact and evaluate for the following reasons:

1.) Lack of available project documentation and supporting energy savings methodologies.

2.) Lack of participant support for the impact evaluation process.

The implementation contractor for the Energy Smart Grocer Program is PECI, and the savings estimates are universally calculated using their proprietary software tool. In response to this preliminary feedback during the Impact Evaluation, PECI presented an overview of the software suite used to generate savings estimates to Navigant. The software allowed for comprehensive energy audits of grocery sites by inputting facility equipment parameters into a spreadsheet based tool during site visits. Although Navigant found the software algorithms to be solid, it was not possible to fully review all of the inputs to the model during the presentation. However, the *ex post* realization rates for ESG projects in the evaluation sample were consistently above 90%, indicating that PECI's software tool is a reliable measure of achievable savings. These findings are consistent with those found in a previous review of an EnergySmart Grocer program administered by PECI for the Bonneville Power Administration.[106]

However, in an effort to improve the efficiency of future impact evaluations, Navigant recommends standardizing data requirements on project application forms to support M&V activities. Navigant also recommends future evaluation efforts closely monitor the quality of project-level documentation provided to support the impact evaluation effort, along with the calculation of project-level realization

[106] *BPA EnergySmart Grocer Program: Process and Impact Evaluations*, September 28, 2009, Summit Blue Consulting, pp. 56-57; http://www.bpa.gov/energy/n/reports/evaluation/commercial/pdf/BPA_ESGrocerProcess_Impact_Eval_9-28-09.pdf

rates. This information can be leveraged to develop measure-specific verification guidelines when low realization rates intersect with prioritized measure technologies (e.g., those measures outside of the ESG program).

Recommendation 2: Request Participants with Energy Management Systems Provide Pre-/Post-Trend Data

Due to the seasonality of HVAC-related measures, an annual energy usage profile is essential for properly correlating savings to changing weather profiles. A majority of projects involving complex technologies (e.g., VFD retrofits on supply and return fans, chiller retrofits, etc.) have both the technology and capacity to store pre-/post-trend data in support of evaluation efforts. This information will serve as an additional data source to consider / contrast during the Impact Evaluation process, thereby improving the accuracy and validity of convergent savings estimates calculated from different resources (e.g., historical billing records, spot measurements, etc.)

Recommendation 3: Normalize Program Schedule Tracking Databases to Enhance Reporting and Evaluation Integrity

Through a review of evaluation *Best Practices*[107] and the Memorandum of development principles designed to guide the construction and integration of a Future Evaluation Database,[108] Navigant identified four industry-accepted standards governing the design of an effective evaluation database. They include:

- The data must be complete enough to accurately describe and quantify what measures and technologies were installed, and what they replaced (if applicable).
- The data must include additional explanatory variables needed to characterize how the measures are applied and their respective operating characteristics.
- Quality Control (QC) metrics must be developed to ensure the integrity of information collected; both computational and manual review processes may drive these metrics.
- The data collection process must be systematic to ensure consistency across the dataset. This will also ensure that the evaluation database(s) seamlessly integrates with PSE's internal data systems.

Adherence to these principles will minimize the potential for data entry error while maximizing the efficiency of data storage. These characteristics will reduce the amount of time and resources spent reviewing and/or correcting any database discrepancies in future evaluation efforts, while yielding more accurate findings.

Recommendation 4: Continue to Incorporate an Economic Analysis Component for Future Evaluations

The economic malaise is a significant *non-programmatic* factor driving realization rates. By continuing to incorporate an economic analysis component in future evaluation efforts, PSE will be able to distinguish between reduced energy consumption achieved through improved controls and efficient measure installations, relative to a decrease in production as a result of economic influencers. Navigant

[107] See Appendix L - Best Practices for Impact Evaluation Measurement and Verification (EM&V) Cycles
[108] See Appendix L – Memorandum: Evaluation Database Guidelines

recognizes that economic volatility occurs periodically, and it is no more valid to choose an "up cycle" than a "down cycle" when evaluating Program Schedule performance. By providing a clear distinction between programmatic and non-programmatic factors affecting the realization rate, future evaluation results will ensure a fair assessment of Program Schedule performance over the EUL of incented measures.

5 Key Opportunities for PSE

This section highlights opportunities for PSE to consider as it moves forward with its C&I energy efficiency retrofit programs. It integrates the key recommendations from previous sections at a high level. Additional detail on these strategies is located in Sections 2.2.4.2 (Market), 3.4 (Process), and 4.5 (Impact).

5.1 *Schedules G205 and E250*

The opportunities presented to PSE for Schedules G205 and E250 overlap almost entirely. This section organizes the key recommendations according to four themes.

5.1.1 Target Specific Sectors

Several sectors are strong prospects for future PSE energy efficiency efforts: offices, public sector, hospitals, and food processors. The approach to each sector varies according to the energy efficiency opportunities available, the conditions in each sector, the balance sheet strength of firms in the sector, and the unique capital budgeting cycle that is typical of those organizations. The unique combinations of conditions in each sector lead to different approaches to realizing the opportunities.

The specific programs within Schedules G205 and E250 can address the varied opportunities in each of these sectors. Table 5-1 summarizes the extent to which each program can serve the opportunities in each sector.

Table 5-1. Sector-Specific Opportunities by Program

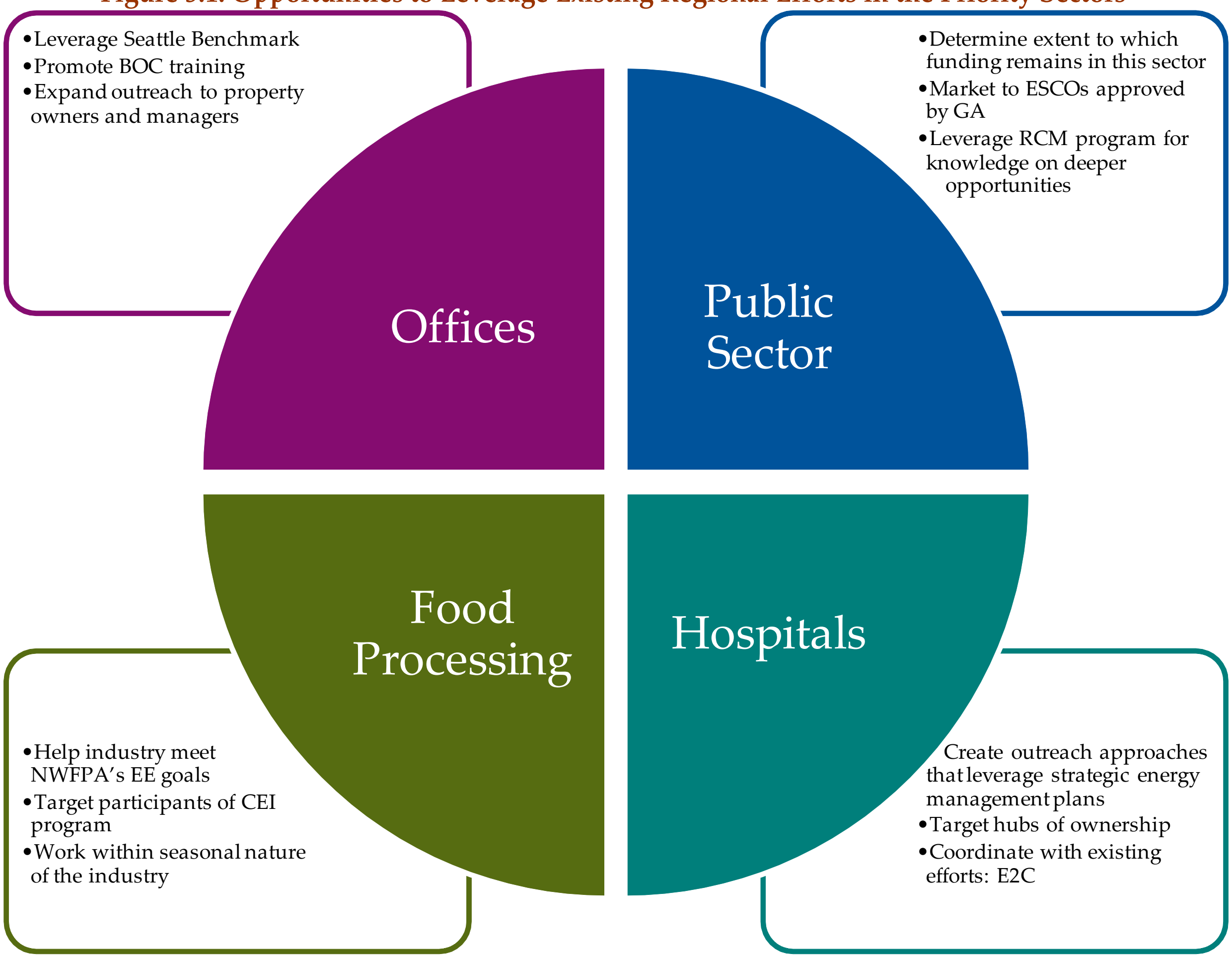
● Good ⦿ Fair ○ Poor	Offices	Public Sector	Hospitals	Food Processors
Energy Smart Grocer	○	○	○	○
BEOP	●	●	⦿	○
Custom Grant – Gas	⦿	⦿	●	●
Custom Grant – Electric	⦿	⦿	⦿	⦿

Source: Navigant analysis 2011.

To reach these segments effectively, PSE may consider hiring staff with sector-specific expertise. This approach enables PSE to tailor its offerings to the unique conditions in each sector. It also enables PSE to deploy technical sales teams with the expertise needed to convince decision makers to adopt energy efficiency. These staff may be internal or third-party staff as long as they are given the flexibility needed to adapt program offerings and marketing to each specific sector.

PSE's program can leverage a wide variety of activities in these sectors in the region to achieve deeper penetration of energy efficiency. Some of these initiatives relied on sector-specific efforts, while other efforts relied on NEEA's investment in these sectors. Figure 5.1 outlines the existing structures and initiatives that PSE may consider integrating into its own efforts to reach these sectors.

Figure 5.1. Opportunities to Leverage Existing Regional Efforts in the Priority Sectors



5.1.2 Reassess the Measure Portfolio

PSE may consider adjusting its portfolio of measures to reflect changing trends among its C&I customers and the broader market.

» LEDs, building automation, and RCx are poised to expand significantly in the next two to five years. Building automation and RCx are closely aligned, as building automation may increase demand for RCx by helping building operators recognize inefficiencies or anomalies in energy use more easily. Developing incentive structures that facilitate straightforward implementation of these measures, coupled with trade ally relationships that promote the adoption of proven technologies, may help PSE to secure cost-effective savings from these important technologies.

» PSE should continue to focus resources on optimizing its new BEOP structure, including considering the following:
   - Simplifying the program per TA and best practice feedback
   - Making the program more transparent by providing savings calculators to providers
   - Opening the program to additional providers
   - Enhancing marketing materials, particularly case studies

» PSE should explore opportunities to increase program efficiency and reduce application processing time. To do so, PSE may consider identifying additional measures that can be made prescriptive. In addition, PSE may consider investing additional resources in developing savings calculators to make calculations more consistent and staff more productive.

5.1.3 Focus Additional Resources on Outreach to Achieve Deeper Penetration

Effective marketing of the programs can enhance program participation. The channels selected for outreach affect the credibility of the message and the customers' response to it in many cases. In addition, the messages used to promote the programs will affect how customers consider the program in light of their other business priorities.

» PSE is already working with a strong set of service providers and internal partners to promote its programs. Building on those efforts, PSE may consider expanding its partnerships with the following entities to enhance its marketing of its C&I offerings:

   - Account representatives and account managers
   - NEEA's partners
   - New account communications
   - Nearby utilities
   - PECI, the implementation contractor for Energy Smart Grocer
   - Business segment managers
   - Energy advisors
   - PSE's government/community relations staff

   Such plans would need to consider associated implications for staffing, training, compensation, and required skills.

» PSE should assess the benefits of reallocating resources from incentives to trade allies and customer support and outreach. Enhancing the relationships with and support of these key partners can lead to stronger marketing channels in the future. Trade allies are looking to PSE for additional marketing and technical support, indicating that case study material is particularly valued. Energy savings and incentive calculators would also provide these partners with additional tools with which to market PSE's program offerings.

» Allocating additional resources to **subsidizing up-front audits** would provide PSE with a low-pressure approach to engaging customers. This would enable PSE to record information about specific opportunities at customer sites, providing a valuable set of information for outreach partners to use in engaging customers. PSE may consider reintroducing the audit for at least a targeted subset of their customers. Other best-practice program approaches can inform the packaging of this tool.

» Two key messages emerged as strong value propositions for PSE's customers. PSE may consider further integrating these key messages in its marketing efforts:

- Energy is a variable cost reduction opportunity.
- Energy efficiency helps to promote a "green" business image.

5.1.4 Expand Functionality of Program Tracking Database

PSE should assure that the new program tracking system provides the functionality that program staff requires for future program delivery.

» The system should address needs for customer relationship management by PSE engineering staff, maintaining records of past interactions and future opportunities.

» System functionality should also enable tracking of key program delivery metrics, such as application processing times, grant payment processing time, and the like, as well as engineering resource commitments and availability.

» The tracking system content should be enhanced to include key trade ally contact information and standardized to ensure consistency in naming conventions to the degree feasible.

Additional best practices for program tracking database design and management can be found in Section 4.1.4.

5.2 Schedule 257

PSE may consider discontinuing the Schedule 257 offerings. Initial findings indicate that this market may be transformed. Governments are choosing to implement traffic light LEDs in the absence of PSE incentives on a regular basis.

5.3 Schedule 258

Preliminary findings indicate that customers are satisfied with this program, seek to continue their participating in it, and have additional project opportunities to pursue.

Evaluation Report Response

Program: C&I Retrofit Programs, Schedules E250, G205, E257 & E258

Program Managers: Jeff Petersen (E250, G205), Joe Schmutzler (E257), David Montgomery (E258)

Study Report Name: Commercial and Industrial Energy Efficiency Retrofit Custom Programs Portfolio Evaluation

Report Date: February 3, 2012

Evaluation Analyst: Eric Brateng

Evaluation Firm: Navigant Consulting, Inc.

Date of ERR: 2/10/2012

Please describe in detail, action plans to address the study's key findings and recommendations.

PSE contracted with Navigant Consulting, Inc. to provide independent 3rd party evaluation services for four of its program schedules: E250, G205, E257, & E258. The evaluation addressed 3 major program elements: Marketing, Process and Impact. Navigant sought input from numerous sources both within PSE and external to PSE in order to provide input and recommendations from all aspects of program delivery.

Marketing: PSE has worked closely with Navigant since early 2011 to provide input into all three aspects of the evaluation – Marketing, Process and Impact. In an effort to advise PSE in its 2012-2013 planning cycle, PSE requested accelerated input for the Marketing portion of the evaluation.

Action: As a result of this input, PSE has considered many of the market findings in its program design for 2012/2013 and has contracted for several 3rd party efficiency programs in targeted customer segments. These programs will augment PSE staff and will enhance the delivery of PSE programs.

Process: Navigant spent a significant amount of time meeting with individuals within PSE and with customers in order to gain a thorough understanding of PSE processes. Interviews were conducted with a broad spectrum of employees and customers who interface with the C/I Retrofit and Self-Directed Programs.

Key findings were that "PSE's custom retrofit program has generated considerable energy savings through program implementation. Spillover and customer feedback on its longer-running custom programs is quite positive. Nonetheless, PSE appears to have a number of opportunities to enhance the efficiency and effectiveness of its custom retrofit programs" as expressed in nine recommendations.

Impact: PSE engineers and supervisors worked with Navigant field staff to address questions and differences in realization rates. The team quickly realized that economic conditions had a significant impact on individual project savings claims. PSE requested that Navigant determine realization rates based on "As Evaluated" observed conditions during site inspections and also provide realization rates as if economic conditions were not a factor, which are listed as the "Economically Adjusted" realization rate. Overall, the Impact Evaluation found PSE's C&I Program Schedules to accurately forecast and assess realized savings. As Evaluated realization rates were 100.3% for E250 & E258 and 102.3% for G205. Impact Recommendations 1 – 4 start on page 7 of this document.

Action: PSE will continue to employ strategies and procedures to ensure that we maintain these robust realization rates.

Process Recommendations, pages 181-183

Recommendation 1:

Schedule 258 Self Direct Program is effective at inducing larger customers to undertake energy efficiency programs, and apparently more effective than Schedule 250 funded programs alone would be with these customers. Navigant recommends that PSE continue efforts to restructure this program per recent discussions with the Conservation Resource Advisory Group (CRAG) and, as feasible, consider applying the program concept of "customer's own funding available to be used or lost" to increase participation of larger Schedule 250 customers.

Action: PSE has completed restructuring efforts and is continuing with the current Schedule 258 program cycle. During 2012-2013 program planning, PSE discussed the possibility of creating an expanded version of its Schedule 258 program which would be available to larger customers eligible for electric Schedule 250 and gas Schedule 205 programs. However, expanding the Schedule 258 program concept to additional rate schedules would require significant levels of accounting in order to track individual customer contributions and remaining dedicated funding allocations per customer. It was determined that added complexities required to administer an expanded program makes it an infeasible option at this time.

Recommendation 2:

As PSE has correctly concluded, retro-commissioning represents an attractive opportunity for increased energy savings, and Navigant recommends that PSE continue to focus resources on optimizing its new (Schedule 205, 250, and, ultimately, 258) BEOP structure, including consideration of the following:

- Simplifying the program incentive structure and documentation requirements per Trade Allies (TA) and best practice feedback
- Enhancing program transparency by providing savings calculators to providers
- Opening the program to additional providers
- Enhancing marketing materials, particularly case studies

Action: Continued increases in BEOP participation during the 2012-2013 planning process led PSE to determine current incentive levels and structure are sufficient to encourage program participation. PSE is operating under its target, budget and program plans for 2012/2013 which maintains the same incentive structure that was used previously. PSE will continue to evaluate the BEOP incentive structure and documentation requirements for opportunities to simplify them and will implement modifications as necessary.

PSE does provide savings calculators where appropriate and continually searches out and employs standard savings calculators where possible for all of its energy efficiency programs. Many energy efficiency measures lend themselves well to standard calculation tools with limited variables. The nature of "optimizing" a building requires non-standard site-specific calculations in order to accurately estimate energy savings.

The 2012-13 program planning cycle was used to further improve the BEOP based on the results of the first year of the program. While PSE continually looks for ways to streamline and simplify the documentation requirements, providers that have participated in more than one project have indicated that the program requirements are clearer for subsequent projects.

PSE has changed program requirements to allow more approved providers for BEOP in an effort to increase participation. Additional staff resources have and will be added to respond to increased customer and trade ally participation.

PSE has also contracted for a simplified 3rd party commissioning program which will be added to PSE's commercial programs to address buildings with less-complex operational issues. This new program will complement PSE's existing commissioning offerings by allowing for a streamlined tune-up of buildings with less complicated operational issues while identifying projects that may require the more thorough investigational and correctional structure offered by the BEOP.

PSE has recognized that trade allies are seeking additional marketing support and case studies. During 2012 we are planning to develop several BEOP case studies of projects that will be available to trade allies and we will feature some of these cases in our quarterly newsletter, Re-Energize Your Business, which is distributed to trade allies.

Recommendation 3:

PSE should assess the potential benefits of reallocating resources from Schedule 205 and 250 custom grant program incentives to Trade Allies (TA) and customer support and outreach.

- TA's are looking to PSE for additional marketing and technical support.
- Case study material appears to be particularly valued.
- PSE should assess the potential for creating savings calculators for TAs that would reduce the uncertainty around likely incentive levels.

Action: PSE realizes and agrees that trade allies are a major contributor to the past and future success of its programs. PSE used the accelerated Navigant Marketing Evaluation results to establish three third-party trade ally-operated programs which have been incorporated into its Schedule E250 and G205 offerings. These programs allow our trade allies to engage in customer support and outreach in specified customer segments and provide expertise required to scope, design and deliver cost-effective projects to Business Energy Management. Outside of this program delivery mechanism, proposed reallocation of resources from the custom grant incentives to Trade Allies and customer outreach will be reviewed and discussed for regulatory compliance and cost effectiveness, along with the potential return on investment for meeting savings targets.

PSE has recognized that trade allies are seeking additional marketing support and case studies. During 2012 we are planning to develop several case studies of projects that will be available to trade allies and we will be featuring some of these cases in our quarterly newsletter, Re-Energize Your Business, which is distributed to trade allies.

Many trade allies provide a savings estimator of their own when submitting a project to PSE or approaching a customer. PSE engineers often solicit and welcome the input from trade allies.

Recommendation 4:

Navigant recommends that PSE assess the potential for leveraging the success of its EnergySmart Grocer (ESG) program, both through replicating its structure as feasible and better leveraging PECI's presence at grocers.

- The ESG program yielded implementation of more measures per customer on average during this period than other programs, suggesting that there are program elements that could merit adopting in other programs and market segments.
- ESG program elements that are common to other strong utility DSM programs include: initial customer audit with timely feedback, staging of measures, customer follow up, and potentially others.
- PSE should consider expanding PECI's measure portfolio beyond just retrofit refrigeration to gas and other electric measures as well as new construction in the grocery store market segment.

- Alternatively, PSE should consider developing a mechanism for PECI to communicate potential opportunities outside their measure portfolio to PSE.

Action: PECI has been very successful in its implementation of the Energy Smart Grocer Program throughout the region and has significantly contributed to PSE's energy savings goals. Virtually all of PSE's grocery customers have implemented at least one measure through the ESG program. Many more have implemented multiple measures. The ESG program achieves much of its success through providing a large list of measures that address technologies common and specific to grocery stores. Market penetration is fairly simple and universally deployable to the target market once these measures have been identified and savings vetted. Measures are funded at a fixed amount per unit installed.

PSE has incorporated many of the attributes that contribute to the success of ESG into its program offerings. Common, limited savings variability measures such as LED lighting, occupancy sensors and specific VFD applications have been converted to fixed incentives. Also, third party programs will provide customers with comprehensive services ranging from audits to construction management and savings verification.

PECI is continually looking at new energy efficiency measures to add to the ESG program. Within the current contract structure, the ESG Program has been expanded to include gas savings measures and lighting measures in convenience stores. Currently new measures proposed by PECI for the ESG program are vetted through the commercial refrigeration subcommittee at the Regional Technical Forum (RTF). New measures are typically proposed with deemed values and require a calibration plan methodology that is accepted by the RTF prior to implementation. Currently, several measures are being proposed or have been proposed under this process including glass doors for open medium temperature refrigerated cases and floating head pressure on single condensing units.

PECI and PSE currently have a feedback mechanism for additional savings opportunities through the ESG program. Savings measures outside of the ESG measure portfolio are referred to the PSE program manager who will evaluate the measure for possible creation of a custom grant.

Recommendation 5:

Navigant recommends that PSE explore opportunities to increase Custom Grant program efficiency and reduce application processing time.

- Possible approaches include identifying additional measures that can be made prescriptive and developing savings calculators to make calculations more consistent.

Action: Application time includes everything from initial facility information gathering through grant payment. A significant portion of this processing time involves data analysis, engineering calculation development and refinement and the verification of assumptions through trend logging, billing analysis and second engineer review prior to grant creation. PSE realizes that the timeline from application to grant payment can vary significantly from project to project and that the variables dictating the timelines are not always apparent to the customer or trade allies. PSE will provide greater clarity to its customers and trade allies regarding the grant process and associated timelines.

PSE is continually looking to identify and transfer custom grant measures into prescriptive rebates where possible. Examples of prescriptive measure creation and process streamlining are:

- In August of 2011, PSE consolidated its approach to funding of screw-in LED lamps. For all PSE programs, LED lamps are now funded via rebate and energy savings per lamp is a Unit Energy Savings (UES) value based on the type of lamp installed.
- Linear fluorescent lamp rebates which provide a lamp wattage reduction are now available to all customers via a standardized application and processing mechanism.
- PSE has created and implemented an Enhanced Lighting Program designed to capture additional lighting efficiency opportunities that exist in a facility, but may be overlooked. This program provides a single-page savings calculation spreadsheet that also serves as a streamlined technical document providing all information necessary to create a grant. Use of this single-page resource reduces project processing time.

PSE is investigating the possibility of modifying the Enhanced Lighting Spreadsheet for use in all lighting projects. The spreadsheet features drop-down menus with standard options designed to both standardize inputs and reduce data entry times.

These consolidated approaches have reduced grant processing time as well as provided for a more consistent approach to savings calculations and funding.

In addition to internal process improvements, Standard Protocols for Commercial measures, being developed by the RTF, will be reviewed and commented on and incorporated into BEM programs where deemed appropriate and applicable. These Standard Protocols promise to streamline calculations and incentive payments.

This evaluation occurred during a period of record program participation levels, primarily due to economic stimulus funding driving accelerated participation in utility energy efficiency programs, which resulted in PSE staff experiencing greater than usual workload. Since the beginning of the evaluation PSE has added engineering staff and is continuing to add staff in 2012 in order to improve project turnaround time and provide more expedient response to customer requests.

In addition to review and evaluation of prescriptive measures, PSE has made changes to its internal processes. PSE has added features to the project tracking database (CSY) to display individual QC workloads in order to more evenly distribute the workload and decrease project turnaround time.

PSE has incorporated an administrative function where grant applications are submitted electronically to a dedicated e-mail address with enough information to establish a project number. By transferring this function to contracts administration, engineering time previously used to perform this task has been eliminated. The payment request process has been incorporated into the tracking program. This process modification has eliminated duplicate data entry, reduced the possibility for data entry errors, and reduced administration time on contracts administration and engineering staff. PSE continues to look for opportunities to improve efficiency in custom grant processing and in late 2011 recruited the services of PSE's Performance Excellence Group to assess the custom grant process and identify potential opportunities for improved efficiency. Recommendations for improvement are expected from the Performance Excellence Group in April 2012.

Recommendation 6:

PSE should review the potential to better utilize its many customer touch points to market its EE programs.

- Best practice utilities are organized to encourage Account Executive, Business Segment Manager, Energy Advisor, and Government/Community Relations staff to bring customers into DSM programs.
- Such plans would need to consider associated implications for staffing, training, compensation, and required skills.
- Further leverage existing trade ally relationships

Action: PSE will continue to work closely with the Major Accounts group, Government/community relations and Energy Advisors to promote energy efficiency programs. PSE will also continue to work with trade allies to enhance relationships.

PSE has recently announced a re-organization of many of its customer-facing business units. The intent of this re-organization is to provide a clear, consistent message and a more streamlined interaction with the many facets of PSE that work directly with the customer to provide energy solutions. By incorporating Business Energy Management into a larger Customer Solutions group, more customer interface points will have the opportunity to communicate Energy Efficiency program opportunities to the customer.

PSE's recently contracted 3rd party programs will leverage existing trade ally relationships by providing additional support and outreach to customers needing energy efficiency services.

In 2011 PSE participated in trade ally events to enable customers to easily take advantage of prescriptive lighting rebates. As part of this event, PSE Energy Management Engineers were on hand to discuss additional energy efficiency opportunities in their facilities that can be funded through the Custom Grant program and other offerings. PSE is discussing the merits of continuing these events in 2012.

Recommendation 7:

Navigant recommends that PSE continue to invest in enhancing its marketing materials and approach around market segments. PSE has already begun to do so with its EE website redesign and with some targeted marketing materials.

Action: PSE is continuing to develop marketing materials and activities that are targeted to particular segments such as lodging facilities, healthcare facilities, data centers and others. PSE has completed the re-organization of the website and is in the process of developing print materials that reflect the approach toward market segments. Business development/outreach tactics that target specific market segments are also under discussion. PSE included the marketing department in its 2012/2013 planning cycle in order to address marketing needs unique to Energy Efficiency. Case studies will be included in the marketing materials. Newly contracted 3rd party program information will be posted on the website also.

Recommendation 8:

Navigant recommends that PSE confirm and then develop specific strategies and tactics to address its target market segments, including potentially the following:

- Manufacturing
- Real estate
- Education
- National chains

Any confirmation should leverage related findings from Navigant's market assessment and could include a deeper review of program uptake to date or in combination a review of current baseline data. Strategies may include target marketing of programs, use of third parties for all or components of program delivery, and use of PSE marketing resources.

Action: Draft results from the Market Assessment provided by Navigant Consulting during the 2012-2013 program planning process influenced the incorporation of 3rd party contracted programs that address target markets that PSE believes have significant potential to generate energy savings.

The portfolio evaluation from Navigant Consulting on the C&I Custom Retrofit Grant program offers good insight into the potential and disposition of four market areas. Three of these, healthcare, food processing and commercial offices, appear to be areas that would benefit from more proactive marketing and outreach during 2012-2013. Additionally, the Commercial Rebates group has identified the lodging industry and the restaurant/commercial kitchen sectors as areas with potential for expansion. The fourth area studied by Navigant, the education/public sector/government facilities area, is one in which we would like to maintain a presence, but do not envision substantial growth for 12-13. All of these areas are likely to have value for both grants and rebates programs.

Recommendation 9:

PSE should ensure that its new program tracking system provides the functionality required for future program delivery.

- Best practice systems address needs for customer relationship management by engineering staff, maintaining records of past interactions and future opportunities.

- System functionality typically enables tracking of key program delivery metrics, such as application processing time, verification process time, grant payment processing time, and the like, as well as engineering resource commitments and availability.
- The tracking system content should be enhanced to include key trade ally contact information and standardized to ensure consistency in naming conventions to the degree feasible.
- To the extent possible, tracking system should be designed to support future reporting and evaluation requirements.

Action: PSE is in the beginning stages of upgrading its customer management system. Energy Efficiency Services currently has a representative on the committee in charge of developing the new Customer Information System (CIS). The long-term goal will be to incorporate many customer interactions into a single program.

Specific to Business Energy Management, PSE is continually improving its project tracking database (CSY). The project tracking database has the capability to list all projects at a customer site for which a grant was issued. Engineers can get a history of efficiency projects completed at the facility.

Naming conventions have been added. For individual projects, projects are listed by facility name and measure for which a grant is being issued. For entities with multiple facilities, the entity is named first, followed by the specific location and the grant measure. Example: XXX School District – YYY Middle School – Lighting.

The current tracking system has the ability to track projects from inception to payment and includes many milestones which can be measured and evaluated for process improvement opportunities. Individual engineer's projects in progress are visible to all. Supervisors are able to review an engineer's workload and re-assign projects as necessary to balance engineering resources.

Impact Recommendations, pages 227-228

Recommendation 1: Standardize Participant Data Requirements

The accuracy of impact evaluation findings is dependent upon the availability and quality of participant measure data. Although a majority of the projects included comprehensive participation data that allowed for the calculation of both *ex ante* and *ex post* energy savings, some projects had insufficient data within the project application to plan evaluation activities. Specifically, projects within the ESG Program were difficult to contact and evaluate for the following reasons:

- Lack of available project documentation and supporting energy savings methodologies.
- Lack of participant support for the impact evaluation process.

The implementation contractor for the Energy Smart Grocer Program is PECI, and the savings estimates are universally calculated using their proprietary software tool. In response to this preliminary feedback during the Impact Evaluation, PECI presented an overview of the software suite used to generate savings estimates to Navigant. The software allowed for comprehensive energy audits of grocery sites by inputting facility equipment parameters into a spreadsheet based tool during site visits. Although Navigant found the software algorithms to be solid, it was not possible to fully review all of the inputs to the model during the presentation. However, the *ex post* realization rates for ESG projects in the evaluation sample were consistently above 90%, indicating that PECI's software tool is a reliable measure of achievable savings. These findings are consistent with those found in a previous review of an EnergySmart Grocer program administered by PECI for the Bonneville Power Administration.[1]

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[1] *BPA EnergySmart Grocer Program: Process and Impact Evaluations*, September 28, 2009, Summit Blue Consulting, pp. 56-57; http://www.bpa.gov/energy/n/reports/evaluation/commercial/pdf/BPA_ESGrocerProcess_Impact_Eval_9-28-09.pdf

However, in an effort to improve the efficiency of future impact evaluations, Navigant recommends standardizing data requirements on project application forms to support M&V activities. Navigant also recommends future evaluation efforts closely monitor the quality of project-level documentation provided to support the impact evaluation effort, along with the calculation of project-level realization rates. This information can be leveraged to develop measure-specific verification guidelines when low realization rates intersect with prioritized measure technologies (e.g., those measures outside of the ESG program).

Action: While all project documentation is not fully contained within a single comprehensive database readily available for automated query, project QC Review checklists, sufficient project documentation and energy savings calculation and verification methodologies are available to support program review & evaluation functions.3rd party program administrators also ensure information is available to support program review and evaluation functions.

Specifically regarding the Energy Smart Grocer Program, program data resides in PECI's Energy Smart Grocer Audit software. This software (Version 4.0), developed roughly at the same time of this evaluation, is approved by the RTF after an extensive vetting process in 2011, which included a detailed calibration plan to validate savings. By providing a rigorous evaluation and vetting process prior to deployment of the 2012-2013 program, the savings methodologies for this program are believed to be sound and consistent region-wide. Individual measure savings are entered into PSE's tracking database and all parameters required for cost-effectiveness evaluation are readily available.

As part of contracts for new programs offered in 2012-2013, PSE has required each 3rd party contractor to commit to providing evaluation support and has standardized reporting criteria for each installed measure to ensure ability to evaluation program cost effectiveness.

PSE recognizes that standardization of project data expedites the evaluation process and is continually making efforts to ensure project documentation is more uniform and databases are expanded to provide more data via automated query. The Enhanced Lighting spreadsheet and Excel-based Grant Input Form are examples of standardized data input that PSE currently employs. PSE will continue to develop additional standardized templates for project-specific data entry that will streamline future evaluation efforts.

Recommendation 2: Request Participants with Energy Management Systems Provide Pre-/Post-Trend Data

Due to the seasonality of HVAC-related measures, an annual energy usage profile is essential for properly correlating savings to changing weather profiles. A majority of projects involving complex technologies (e.g., VFD retrofits on supply and return fans, chiller retrofits, etc.) have both the technology and capacity to store pre-/post-trend data in support of evaluation efforts. This information will serve as an additional data source to consider / contrast during the Impact Evaluation process, thereby improving the accuracy and validity of convergent savings estimates calculated from different resources (e.g., historical billing records, spot measurements, etc.)

Action: All PSE retrofit grant analyses include a review of facility annual energy usage profiles and validation of measure baseline energy use against the annual consumption analysis. PSE typically requests pre–installation trend logging if it is available and the system is capable of providing trend logs. In many situations, the system being replaced lacks the capability to provide meaningful trend logs. PSE routinely requests post installation trend data for weather-dependent measures and projects involving complex technology.

Data logging duration is sufficient to verify proper equipment and system operation, but not unduly affect prompt incentive payment to the customer. In addition to trend logging, PSE verifies that stated setpoints, schedules and the design intent of the measure installation are met.

Recommendation 3: Normalize Program Schedule Tracking Databases to Enhance Reporting and Evaluation Integrity

Through a review of evaluation *Best Practices*[2] and the Memorandum of development principles designed to guide the construction and integration of a Future Evaluation Database,[3] Navigant identified four industry-accepted standards governing the design of an effective evaluation database. They include:

- The data must be complete enough to accurately describe and quantify what measures and technologies were installed, and what they replaced (if applicable).
- The data must include additional explanatory variables needed to characterize how the measures are applied and their respective operating characteristics.
- Quality Control (QC) metrics must be developed to ensure the integrity of information collected; both computational and manual review processes may drive these metrics.
- The data collection process must be systematic to ensure consistency across the dataset. This will also ensure that the evaluation database(s) seamlessly integrates with PSE's internal data systems.

Adherence to these principles will minimize the potential for data entry error while maximizing the efficiency of data storage. These characteristics will reduce the amount of time and resources spent reviewing and/or correcting any database discrepancies in future evaluation efforts, while yielding more accurate findings.

Action: While the CSY database does not currently include "explanatory variables" and baseline condition documentation to allow an automated query of all parameters required to conduct impact evaluation activities, PSE currently maintains all of the information mentioned above in its project files and employs QC procedures to ensure information integrity. Existing and new 3rd party energy efficiency programs are also required to submit standardized data in a manner that aligns with internal project data sets. PSE is continually working to improve its project tracking database and most recently has made significant advances in capturing additional data required to calculate program cost-effectiveness at higher resolution. As database capabilities are enhanced and expanded, evaluation activities will be streamlined through more comprehensive data being readily available for automatic query.

Additionally, PSE is investigating the possibility of employing a standardized project file system on the network drive to ensure consistency in organization of project documentation in electronic format to allow easier extraction and transfer of individual project information to reviewers and evaluators.

[2] See Appendix L - Best Practices for Impact Evaluation Measurement and Verification (EM&V) Cycles

[3] See Appendix L – Memorandum: Evaluation Database Guidelines

Recommendation 4: Incorporate an Economic Analysis Component for Future Evaluations

The economic malaise is a significant *non-programmatic* factor driving realization rates. By incorporating an economic analysis component in future evaluation efforts, PSE will be able to distinguish between reduced energy consumption achieved through improved controls and efficient measure installations, relative to a decrease in production as a result of economic influencers. Navigant recognizes that economic volatility occurs periodically, and it is no more valid to choose an “up cycle” than a “down cycle” when evaluating Program Schedule performance. By providing a clear distinction between programmatic and non-programmatic factors affecting the realization rate, future evaluation results will ensure a fair assessment of Program Schedule performance over the EUL of incented measures.

Action: PSE recognized that the economic downturn was likely to alter the output and operations of participating businesses during this evaluation and requested Navigant to expand their realization rate analysis. Navigant responded by producing three realization rates; As Evaluated, As Installed, and Economically Adjusted, to provide a clearer distinction between programmatic and non-programmatic factors affecting energy savings. The results of this exercise are included in the Evaluation Report. To the extent possible and when warranted PSE will request similar treatment in future evaluations.

D. Home Energy Report documentation

This appendix contains two documents that support PSE's revised savings claim for the Home Energy Report (HER) program. The first is the final independent evaluation of the program, which served as the basis for calculating the savings revision. The second is a WUTC-commissioned study by Lawrence Berkeley National Labs that concluded that the KEMA analytical approach was sound.

Puget Sound Energy's Home Energy Reports Program

Three Year Impact, Behavioral and Process Evaluation

Puget Sound Energy
Prepared by DNV KEMA Energy & Sustainability
Madison, Wisconsin, April 20, 2012

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1. Executive Summary

1.1 Program Background

In 2008, Puget Sound Energy (PSE) became the second utility in the U.S. to implement an innovative program designed to conserve energy. The program, referred to as the Home Energy Reports (HER) program, utilizes a social marketing campaign, with normative messaging techniques, to encourage responsible energy behavior and choices. The campaign, administered by OPOWER, provides Home Energy Reports to households in PSE's combined gas and electric service territory. The current program serves dual fuel, single family households. The Home Energy Reports provide recipients with feedback on their household energy use by comparing the recipient household's energy usage with that of neighboring homes, essentially using peer pressure to achieve energy savings. In addition, the reports provide tips regarding steps households can take to reduce energy consumption through behavioral changes and participation in other PSE energy efficiency programs.

After the second year of the PSE HER Program, a subset (approximately 10,000) of the original HER treatment group were randomly selected for program suspension; the sending of Home Energy Reports was suspended to these households. The estimation of program savings among the suspended treatment group is important to include for several reasons:

- To the extent that there are continued energy savings program effects on the suspended group beyond the years for which they received reports, the suspended group represents cost-free retention of savings. It is essential to understand the magnitude of those cost-free savings and potentially deal with them separately from the perspective of cost-effectiveness
- Understanding the impacts of suspending program treatment on energy usage will assist utilities in making more informed decisions regarding optimal deployment of the HER program; providing a possible avenue to maximize savings with a fixed expenditure.

1.2 Evaluation Overview

The evaluation included impact, behavioral and process evaluation components designed to address multiple objectives, which are outlined in Table 1-1.

Table 1-1: Evaluation Objectives by Research Type

<table>
<tr><th>Research Type</th><th>Objective</th></tr>
<tr><td rowspan="5">Impact Evaluation</td><td>Determine HER program savings based on consumption analysis</td></tr>
<tr><td>Assess whether, and to what extent, there may be double counting of energy savings in the billing analysis estimates, due to coincident participation in other PSE programs (rebate and upstream)</td></tr>
<tr><td>Determine HER program savings net of any double counting</td></tr>
<tr><td>Quantify program savings for current treatment vs. suspended treatment groups</td></tr>
<tr><td>Quantify program savings for households receiving Home Energy Reports monthly vs. quarterly</td></tr>
<tr><td rowspan="2">Process and Behavioral Evaluation</td><td>Assess how HER treatment households are saving energy by examining program effects on:
• Household purchase/installation of energy efficiency measures, with a focus on purchases outside of PSE rebate programs, and
• Household energy saving behaviors</td></tr>
<tr><td>Assess customer response to HER reports</td></tr>
</table>

To meet the objectives, several analysis techniques and data sources were required to complete the evaluation. The programs savings, or consumption reduction, analysis used daily billing data to measure the difference in consumption between the following groups: current and suspended treatment vs. control group; current treatment vs. suspended; and monthly vs. quarterly. To quantify the potential for double counting of energy savings in the billing analysis due to participation in PSE rebate programs, KEMA utilized PSE tracking data and end-use load shape data. To examine double counting due to participation in upstream lighting programs, for which there is no tracking data, we used household survey data. Additionally, surveys were used to gather information on participant attitudes, behaviors, and energy related purchases outside of PSE programs. The survey instrument was also utilized to gather information on consumer responses toward receiving reports.

1.3 Key Findings

1.3.1 Impact Evaluation Results

KEMA conducted two separate evaluations on the HER program for PSE. We first conducted an evaluation of the savings which occurred during the calendar year 2011, which assisted PSE in supporting HER savings claims for 2011. We then conducted a complete longitudinal study over the three HER programs years. This second component assists in understanding how savings persist over time when people continue receiving reports and when households are suspended from the program. For clarity, the impact results are summarized separately for calendar year 2011 and for the three year program evaluation. A summary of results of the 2011 calendar year savings are reported in 1.3.1.1. The summary Results from the three year study are presented in section 1.3.1.2

A Primary overall objective for this evaluation was the development of estimates free of any double counting of savings that were credited to other PSE energy efficiency programs. The savings that may be double counted are produced and tracked through activity in PSE rebate and upstream programs but are influenced by the HER program. We refer to these savings as "joint" savings. The initial HER program savings estimates include these joint savings. To avoid double counting them, they must be removed from the estimates of HER Program measured savings. This evaluation develops the correct way to measure joint savings and uses this approach to develop credited savings estimates (measured savings with joint savings removed) for calendar year 2011.

1.3.1.1 Calendar Year 2011 Impact Results Summary

Both continued and suspended treatment groups generated statistically significant energy savings in calendar year 2011. Table 1-2 summarizes the household level measured savings generated by the HER program and the savings credited to the program after removing joint savings claimed by other PSE programs.

Table 1-2: Calendar Year 2011 PSE HER Program per Household Savings Estimates

HER Treatment Group	Source	Electric (kWh)	Gas (therms)
Continued Reports	Measured Savings	278.4 (241.00 , ∞)	12.9 (10.34 , ∞)
	Credited Savings	276.4 (195.38 , ∞)	11.6 (9.05 , ∞)
Suspended Reports	Measured Savings	208.1 (159.88 , ∞)	12.0 (8.65 , ∞)
	Credited Savings	164.3 (82.71 , ∞)	10.9 (7.62 , ∞)

Table 1-3 summarizes the HER program results with respect to average consumption for participating households. The continued treatment group produced credited savings at 2.6 and 1.3 percent for electric and gas, respectively. The suspended treatment group produced credited at 1.6 and 1.2 percent, for electric and gas, respectively.

Table 1-3: Calendar Year 2011 PSE HER
Credited Savings (Joint Savings Removed) as a Percent of Consumption

Her Treatment Group	Electric (kWh)			Gas (therms)		
	Consumption*	Savings	Percent	Consumption*	Savings	Percent
Continued Reports	10,596	276.4	2.6%	920	11.6	1.3%
Suspended Reports		164.3	1.6%		10.9	1.2%

*Control Group calendar year 2011 consumption

Table 1-4 summarizes the total program savings for all households in the two treatment groups and for the full program.

Table 1-4: Calendar Year 2011 Final PSE HER
Overall Program Credited Savings Estimates

HER Treatment Group	Source	Electric (kWh)	Gas (therms)
Continued Reports	Total Group Credited Savings	5,443,983 (3,848,433 , ∞)	228,479 (178,298 , ∞)
Suspended Reports	Total Group Credited Savings	1,589,582 (800,117 , ∞)	105,554 (73,744 , ∞)
Total Program Credited Savings		7,033,565 (4,866,495 , ∞)	334,033 (267,373 , ∞)

Other calendar year 2011 findings:

- Table 1-2 reports the relative levels of continued and suspended treatment group saving for both measured and credited savings.
  - Suspension of reports resulted in a decrease in measured savings by 25 and 7 percent for electric and gas, respectively. The electric difference was statistically significant while the gas difference was not.
  - For credited savings, the suspension of reports resulted in a decrease in credited savings (measured savings with joint savings removed) of 41 and 6 percent for electric and gas, respectively. Neither of these differences was statistically significant due to the additional variability from the incorporation of the joint savings estimates
- The HER Reports had a positive influence on participation in other PSE programs. The reports increased savings produced by gas measures from rebate programs. For the continued group, 10 percent of measured savings was due to participation in other PSE programs. For the suspended group, 9 percent of the measured savings was due to participation in other program. The percent savings which are due to joint program participation are statistically significant for both the continued and suspended treatment groups. Neither group experienced statistically significant electric savings due to joint program participation.
- The HER Reports did not increase savings produced by electric measures from rebate programs. Less than one percent of measured savings was due to participation in other PSE programs for both treatment groups. Neither estimate was statistically significant.
- Upstream CFL program joint savings were not statistically significant. Survey results indicated that suspended treatment households purchased about a half bulb more of program CFLs than the control households. Expanded to three years, this amounted to 43 kWh in joint savings for the upstream CFL programs for this group. Upstream joint savings was only 2 kWh for the continued treatment group.

1.3.1.2 Three Year Impact Evaluation Findings

Table 1-5 presents a summary of the three year impact evaluation results. The PSE HER Program generated statistically significant savings for all three years. The suspended group, which did not receive reports in year three, continued to generate savings even without the report.

Table 1-5: PSE HER Program per Household Weather Normalized Savings

Year and Group	Electric (kWh)	Gas (therms)
Year 1	169.7 (149.70 , ∞)	10.7 (9.27 , ∞)
Year2	234.5 (207.25 , ∞)	13.5 (11.61 , ∞)
Year 3 - Continued	274.2 (238.01 , ∞)	11.9 (9.59 , ∞)
Year 3- Suspended	216.4 (169.77 , ∞)	11.9 (8.85 , ∞)

The weather normalized electric results show savings increasing each year, although the savings appear to be increasing at a slower rate between years two and three. Weather normalized gas results show gas savings increasing from year one to year two but dropping slightly in the third year.

The normalized, third year results indicate a more moderate effect of suspension of the reports on savings. Suspending Home Energy Reports lowered measured savings in the first year post suspension by 21 and 0 percent for electric and gas, respectively. The electric result was statistically significant. The difference between these results and the 2011 results is primarily explained by the different time period. The third year results look at the first 12 months of report suspension (November, 2010 to October, 2011), whereas the 2011 results look at months three through thirteen.

The three year impact evaluation also considered the differences between monthly and quarterly mailings across the three years. Less frequent quarterly reports continue to generate fewer savings than monthly reports in the third year. In addition, visual evidence suggests that the quarterly reports may also level out and/or decline sooner than the monthly reports. When reports were suspended, households receiving monthly reports reduced electric savings more than household receiving quarterly reports. Gas results were inconclusive.

1.3.2 Behavior and Process Evaluation Results

1.3.2.1 Behavior Evaluation Results

The primary objective of the behavior analysis was to better understand how HER treatment households save energy. This is a challenging endeavor as HER program-related savings are a small percentage of overall consumption and could be generated by energy-related purchases and behaviors across all categories of energy use.

The survey results indicate increased HER Program purchase of energy efficient products outside of PSE programs across a range of specific measures including tank water heater, clothes washer, TVs, computers and insulation. The differences in purchases of these specific measures, between treatment and control households, were small but statistically significant. These results drove statistically significant increases in energy efficient purchases in the broader, measure-related categories of water heat, electronics and appliances. All of these results were for either the continued or suspended report treatment groups. While there was evidence of energy efficient purchasing behavior in general there was little similarity between the two treatment groups as to where it took place.

Similarly, the survey results also show an increase in measure-related behaviors and energy use behaviors for the HER Program treatment groups. There were a limited number of specific behaviors for which there was a statistically significant increase for at least one of the treatment groups. Overall, the measure-related and energy saving behaviors showed a more consistent pattern of increase energy saving behaviors across both groups than the energy efficient purchases.

Given the survey results presented here, the observed consumption reduction of the treatment group is the cumulative effect of a number of small differences in energy related behavior and purchases. Although the small differences in energy usage behavior may be too small to observe individually, without impractically large samples, they create a measureable difference in energy savings on the aggregate.

1.3.2.2 Home Energy Report Response Summary

The survey asked HER report recipients what they thought of the reports. The data indicates that respondents are aware of the reports. Most respondents spend a few minutes reading every report their household receives but home occupants do not appear to be overwhelmed with the usefulness of the reports. The most useful component of the reports is the comparison of the respondents' continued energy usage to the previous year. About one-third of respondents said the reports caused them to adopt new energy saving habits or install energy efficient equipment.

2. Introduction

2.1 Program Description

In 2008, Puget Sound Energy (PSE) became the second utility in the U.S. to implement an innovative program designed to conserve energy, which is referred to as the Home Energy Reports Program (HER). The program utilizes a social marketing campaign, with normative messaging techniques, to encourage responsible energy behavior and choices. The campaign, administered by OPOWER, provides Home Energy Reports to households in PSE's combined gas and electric service territory. The current program serves, dual fuel, single family structures. The Home Energy Reports provide recipients with feedback on their household energy use by comparing the receiving household's energy usage with that of neighboring homes, essentially using peer pressure to achieve energy savings. In addition, the reports provide tips households can take to reduce energy consumption through behavioral changes and participation in other PSE energy efficiency programs.

After the second year of the PSE HER Program, a subset (approximately 10,000) of the original HER treatment group were randomly selected for program suspension; the sending of Home Energy Reports was suspended to these households. The estimation of program savings among the suspended treatment group is important to include for several reasons:

- To the extent that there are continued energy savings program effects on the suspended group beyond the years for which they received reports, the suspended group represents cost-free retention of savings. It is essential to understand the magnitude of those cost-free savings and potentially deal with them separately from the perspective of cost-effectiveness
- Understanding the impacts of suspending program treatment on energy usage will assist utilities in making more informed decisions regarding optimal deployment of the HER program; providing a possible avenue to maximize savings with a fixed expenditure.

2.1.1 Home Energy Report

Appendix D contains a copy of a monthly report generated though the HER program. The reports contain an individualized bar graph of the receiving household's gas and electric usage from the prior month, a rolling twelve month average of the electric and gas usage in separate graphs, and plots of the receiving household's gas and electric usage compared to that of their average neighboring homes. During the months the receiving home uses less energy than the average of their defined neighbor group, an emoticon of a smiling face is displayed on the report. When the receiving household's energy usage is higher than the average of the defined neighbor group, the report indicates that the receiving home's usage is above average.

In addition to the usage information, the report provides customized tips on lowering household usage by doing a variety of things from small behavior changes to taking advantage of retrofit opportunities

Each month, the report provides three tips, which are different from tips received in prior months. Tips almost always include a no-cost behavior modification, a low-cost equipment change, and a medium cost appliance upgrade. Sample tips include: lowering the temperature of the water heater serving the home, installing a programmable thermostat, installing compact fluorescent lighting, and upgrading to a more efficient furnace. Tips also direct recipients to a website (www.pse.opower.com) that provides other useful tips, tools and forums for conserving energy.

When the report provides a tip that is supported by a PSE rebate program, additional details about the rebates PSE offers are included. The objective of the tips, along with the rebate information, is to increase participation in PSE programs. Therefore, these reports serve the dual purpose of encouraging people to save energy through behavior modification and through participation in other PSE programs.

2.2 Evaluation Objectives

The specific objectives of the evaluation are provided in Table 2-1.

Table 2-1: Evaluation Objectives by Research Type

Research Type	Objective
Impact Evaluation	Determine HER program savings based on billing data analysis of consumption reduction
	Assess whether, and to what extent, there may be double counting of energy savings in the billing analysis estimates due to coincident participation in other PSE programs (rebate and upstream)
	Determine HER program savings net of any double counting
	Quantify program savings for continued treatment vs. suspended treatment (dropped from program after two years)
	Quantify program savings for households receiving Home Energy Reports monthly vs. quarterly
Behavioral and Process Evaluation	Assess how HER participants are saving energy by examining program effects on: • Household purchase/installation of energy efficiency measures, with a focus on purchases outside of PSE rebate programs, and • Household energy saving behaviors
	Assess customer response to HER reports

2.3 Overview of Approach

This section provides a high level synopsis of the impact evaluation and the behavioral and process evaluation approaches.

2.3.1 Impact Evaluation Overview

To meet the impact evaluation objectives, KEMA analyzed consumption data provided by PSE. KEMA used consumption data read on a daily basis for the analysis, and used two different approaches to measure impact. A difference-of-differences approach is a simple, robust approach to measuring actual (as opposed to typical year) impacts. This approach is the basis for PSE savings claims. KEMA also conducted individual household regression analysis, allowing us to estimates of savings for a normal weather year. These results are used for additional analysis of the program.

KEMA also analyzed PSE rebate program tracking data to identify possible increased uptake of other PSE energy efficiency programs by the treatment group. For this analysis, KEMA compiled data on all rebated installations, for both the treatment group and the control group, and measured the associated savings in two different ways:(1) assigning all first year savings to the day of installation, and (2) spreading savings over the first year of installation using a measure-specific load shape as a guide to specify when savings would be credited. These estimates represent the potential overlap between the HER program and the PSE rebate programs

Finally, using data collected for the process evaluation, KEMA developed estimates of increased uptake of CFL bulbs and fixtures that were supported by the PSE upstream lighting program. These estimates represent the potential overlap between the HER program and the upstream light programs.

2.3.2 Behavioral and Process Evaluation Overview

The meet the behavioral and process evaluation objectives, KEMA conducted a customer survey of households, including continued treatment group, suspended treatment group and control group households. KEMA compared the survey results for each of the three groups to assess the extent and nature of HER program effects on household energy efficiency equipment purchases and energy saving behaviors.

2.4 Overview of This Report

Section 3 of the report presents the overall research design and data collection activities. Section 4 and Section 5 present the approach and results for the impact evaluation and behavioral and process evaluation, respectively.

3. Research Design and Data Collection Activities

3.1 Experimental Design

Before the program launched, a group of 83,811 single family homes, located in PSE's combined gas and electric service territory, were selected to participate in the test and control group based on the following criteria:

- Dual Fuel (home uses both natural gas and electricity, which are both provided to the service address by Puget Sound Energy)
- Single family residential home
- Uses more than 80 MBtu of energy per year
- Home does not utilize a Solar PV system
- Address must be available with parcel data from the county assessor
- Has a bill history that starts on or before January 1, 2007
- Home must have 100 similar sized homes (neighbors) within a two mile radius
- Home must have automatic daily meter reads

After selection of the participating households was complete, 39,755 homes were randomly assigned to participate in the treatment group and the remaining homes were used to serve as a control group. Of the selected treatment homes, 9,949 (25%) were randomly selected to receive Home Energy Reports on a quarterly basis, while the remaining 29,806 (75%) homes are participating as monthly report recipients. The random assignment of monthly and quarterly reports allows both Puget Sound Energy and OPOWER to test the effect of report frequency on energy savings.

The program was implemented in October 2008 and for the first two program years (November 2008 – October 2010) the 39,755 treatment group households received a Home Energy Report on the monthly or quarterly schedule per their assignment. In Program Year 3- beginning November 2010- 9,674 treatment group homes were randomly assigned to stop receiving the Home Energy Reports (suspended treatment group).

The impact and process evaluation used information collected from customer billing data, program tracking data and customer survey data. These data collection activities are described in the following sections.

3.1.1 Billing Data

The data used in analysis included daily electric and gas consumption, frequency of report delivery, site-level characteristics, and actual and normal weather data. Daily billing data were provided by PSE's Meter Data Warehouse for each home included in the treatment and control groups from January 2007 to December 2011. PSE also provided data on move-out dates, monthly and quarterly assignments, and a report delivery suspension indictor for home suspended from the program after year two, and household square footage information. .

Table 3-1 summarizes the data received from PSE. Household where occupancy changes occurred during the analysis period were removed from the final HERS population, as PSE indicated they will not be seeking to claim savings homes which experienced occupancy changes. Roughly 15 percent of the households in the treatment and control groups moved or changed accounts since the program began. In addition, households in zip codes where no control group was assigned were also removed from the analysis. Approximately 12 percent of the treatment group was located in zip codes that did not have an assigned control group. Table 3-1 provides a summary of the program population, counts of removed households, and the final sample used in the billing analysis.

Table 3-1: Consumption Data Disposition

Groups	Initial Program Population	Non-Randomly Assigned	Other Opower Program	Moved out	2011 HERS population	Data Issues	Final Analysis Sample
All Control	44,089	-	114	6,531	37,452	358	37,094
All Treatment	39,715	4,861	-	5,858	29,675	304	29,371
Monthly - Not suspended					*14,274*		*14,128*
Monthly - Suspended					*5,625*		*5,569*
Quarterly - Not suspended					*6,981*		*6,903*
Quarterly - Suspended					*2,795*		*2,771*
Total	83,804				67,127		*66,465*

For this evaluation, the data for billing analysis was divided into five periods: October 2007 to September 2008 (Pre-program), November 2008 to October 2009 (Post Year 1), November 2009 to October 2010 (Post Year 2), November 2010 to October 2011 (Post Year 3) and January 2011 to December 2011 (Post Year 3). The month of October 2008 was excluded from the analysis because of a mixture of pre and post-report period for some households in the treatment group.

Prior to analysis, KEMA examined the billing data of HERS population for data issues such as duplicates, extreme values, missing observations and inconsistencies. Data preparation steps included:

- Duplicate reads
  - When meters produced two identical reads in one day, one read was excluded from the analysis.
  - When a meter produced two different reads in a day, both reads were excluded from the analysis.
- Negative reads were excluded from the analysis.
- Extreme values, greater than 100kWh per day or 20 therms per day, were excluded from the analysis.
- Missing daily observations, caused by missed daily reads, were generally followed by a single read that covered the multiple missing days. Data imputation was employed by distributing energy consumption of that next non-missing meter read. Imputation was only done when the next non-missing read covered the missing period as indicated by start and end read dates.
- All households with less than 122 days of data during any of the four years (one pre- and 3 post-program) were removed from the final analysis dataset.

3.1.2 Participant Survey

The KEMA team utilized a Computer Aided Telephone Interview (CATI) survey to collect data used in the analysis of upstream lighting program participation and the energy efficiency purchases and behaviors associated with the HER program . KEMA selected a random sample of 5,966 households from the HER treatment (continued and suspended) and control groups for possible interview; a total of 1,369 interviews (502 control, 373 continued treatment, and 494 suspended treatment) for a final response rate of 27 percent. All respondents were called eight times over at least two weeks before being considered unreachable. Table 3-2 provides counts of surveyed households and response rates.

Table 3-2: Survey Dispositions

Sample Description	Number	Percent
Starting Sample	**5,966**	
Never Called	-	
Sample Used	**5,966**	
Known Not Eligible	528	
Estimated additional not eligible	348	
Sample-Valid	**5,090**	
Complete	1,369	27%
Refused	1,540	30%
Not Completed - Eligible	158	3%
Not Completed - Est. Eligible	2,023	40%

Ineligible sample consisted of completed calls with respondents who were not HER treatment or control group participants or not able to answer questions as HER participants. This happened largely because of changed telephone numbers.

The survey addressed the following key topics:

- Energy efficiency equipment purchases including: CFLs (bulbs and fixtures), heating and cooling system purchases, water heating systems, insulation, appliances, and electronic equipment
- Energy saving behaviors in the areas of home heating, air conditioning, lighting, hot water, appliances, and electronics
- Responses to the Home Energy Reports
- Respondent demographics

4. Impact Evaluation

This impact evaluation provides estimates of energy savings over the three years of HER program implementation and for calendar year 2011. The evaluation provides total energy savings estimates for the HER program and an estimate of the portion of those savings that will be credited to HER program.

Savings for the HER program are expected to be small, as a percentage of overall consumption, and the exact source of savings is not explicitly known. The program experimental design, a large population with randomly assigned treatment and control groups, makes it possible to develop precise and unbiased savings estimates despite these challenges. Because of the experimental design, the HER program impact evaluation can claim impact evaluation results that are more robust than most other energy efficient evaluations despite the small magnitude of the savings.

The Home Energy Report program has a secondary objective of promoting other energy efficiency programs within PSE. If this promotion is successful, some portion of the true savings, measured by the basic HER Program impact estimates, will include part or all of the savings claimed by those other programs. We refer to this as joint program savings because the ownership of these savings are shared by both the HER program and other PSE programs. A key part of a HER Program impact evaluation is identifying joint savings and clarifying how PSE accounts for these savings. For PSE, there are potential joint savings with rebate programs and upstream CFL and Fixture programs. These sources and identification of joint savings are addressed separately for rebate programs and upstream CFL and Fixture programs.

Finally, it is important to note that because of the experimental design framework of the HER program, freeridership is not an issue.

4.1 Billing Analysis Approach

The impact evaluation uses an analysis of daily household energy consumption data (billing analysis) to estimate the reduction in energy consumption resulting from HER. This consumption reduction is the full measure of savings caused by the mailing of Home Energy Reports and is referred to here as measured savings. This measure savings will include any joint savings with other PSE programs. Joint savings are discussed in the subsequent sections, and are ultimately removed from this initial estimate of measured savings to avoid double counting. The measured savings- net of the joint savings- will be referred to as “credited savings”.[1]

The billing analysis uses two different approaches, a difference in differences technique and a site-level modeling approach, to estimate savings. The approach we refer to as the difference-in-difference technique provides estimates of actual annual and monthly savings during the three program years. The site-level modeling approach produces estimates of savings that are normalized to reflect typical weather year data. The former approach provides the basis for ex post savings claims, and the latter approach facilitates general analysis of program performance over time

4.1.1 Difference in differences Approach

The difference-in-differences approach is a simple, robust approach to measuring program-related savings in a randomized experimental design framework. The approach compares mean energy consumption between the pre- and post-report periods for both the treatment and the control groups.

A simple pre-post comparison of treatment group consumption- without a control group- does not account for systemic effects (economic factors, fuel prices, etc) that impact all households’ consumption patterns during the measurement periods. It is possible that these systemic effects will increase or decrease consumption in the post-report period unrelated to the effects of the reports. This would bias the estimate of consumption reduction, a particular concern when expected reduction is relatively small. The control group, pre-post difference provides a robust estimate of the non-program, systemic effects on consumption that are observed in the post-report period. Because the control group was randomly assigned, their response to the systemic effects is representative of the treatment group response. The term “difference-in-differences” refers to the removal of the of the control group difference (systemic effects only) from the treatment group difference (program effects and systemic effects).

A full discussion of the difference in difference approach can be found in Appendix A.1

[1] We explicitly avoid using the gross/net terminology here to avoid confusion with the more typical freeridership/spillover usage of those terms.

4.1.2 Regression Approach

A second approach, based on regressions performed for each individual household, was applied to the data to develop more in-depth estimate of the HER Program savings over time. The regression-based approach allowed KEMA to estimate weather impacts on energy consumption, which could not be done in a difference-in-difference approach. Estimating the weather impacts on consumption allowed KEMA to compare real year-to-year program savings estimates by modeling each year's savings under the same normal weather conditions. Without doing this, it is difficult to judge whether trends are real or the impact of variable weather.

A full discussion of the site-level modeling approach can be found in Appendix A.2.

4.2 Joint Savings Analysis Approach

The goal of the joint savings[2] analysis is to quantify savings that are included in the measured savings but that are already credited to other PSE energy efficiency programs.

4.2.1 What are Joint Savings

Because the HER program participants are not barred from participating in other PSE programs, there is potential for both treatment and control households take part in energy efficiency programs. If savings from participating in other PSE programs were the same between the treatment and control groups, those savings would not be captured as HER savings in the difference of difference analysis. With the HER program promoting the energy efficiency programs, it is expected that the treatment group would take greater advantage of the energy efficiency programs. That incremental activity will be captured in the difference of difference analysis. The energy efficiency programs are credited for all the savings the energy program participants create through program measures. This includes all the savings generated by both groups as well as those incremental savings caused by the HER program. It is only this incremental part of the savings that are joint savings and need to be removed from consumption analysis

The reduction in consumption associated with HER program participation, as measured in the consumption analysis, may be roughly categorized into savings from the following sources:

[2] Sometimes referred to as uplift in other evaluations.

- Behavioral changes.
- Energy efficient installations and activities performed outside of PSE energy efficiency programs
- Energy efficient installations and activities rebated through PSE energy efficiency programs

The full amount of savings from the first two sources are uniquely attributable to the HER Program. The last source, HER program savings generated through PSE energy efficiency programs, are not uniquely attributable to the HER program. These savings are generated in concert with the other PSE sponsored programs. For PSE, the decision has been made to assign the credit for these savings to the rebate program. This means these savings must be removed from the HER program measured savings before the HER savings can be claimed by PSE.

Joint savings occur when recipients of Home Energy Reports (the treatment group) yield a higher savings from other PSE Programs compared to the control group. Increased savings from other PSE programs occur when recipients:

- Install rebate program measures in greater numbers
- Install rebate program measures generating greater savings, and/or
- Install any rebate program measures earlier than control households, regardless of the level of savings.

These effects, measured on a day by day basis, will generate additional savings among treatment households that will be captured in the measured consumption reduction. Where these savings have already been credited to another PSE program, they must be removed from measured savings to avoid giving double credit for those savings.

4.2.2 Accounting for Joint savings

The first priority with regards to accounting for joint savings is recognizing that these joint savings with other utility energy efficiency programs need to be accounted for at all. Programs like the Opower program are relatively new and the joint savings are somewhat unique to this kind of program. The potential for double counting due to the way HER program savings are measured, however, is real and must be addressed.

The next priority is determining the appropriate way to account for joint savings, given the way HER Program savings are measured.

Energy efficiency program savings are generally reported on an annual basis. For this kind of accounting, it does not matter when during the year measures are installed or when during the year the savings actually happen. This level of energy efficiency program accounting makes it difficult to measure joint savings in a way that allows for their removal from HER program savings.

In contrast to a simplified annual savings accounting process, the overall savings generated by the HER program are changing day to day. For example, over the course of the first year of the program savings increased from zero to a substantial level of savings. HER Program savings are a flow of savings that increases or decreases as the consumption of the treatment group changes compared to the control group. The consumption analysis captures these savings on a day to day basis.

To integrate energy efficiency program savings into the framework of the HER consumption analysis, the program savings also need to be captured as flow of savings. In this case, it is a flow of program-related savings that will increase or decrease as the participation of the treatment group in the energy efficiency programs changes compared to the control group on a day to day basis. To account for energy efficiency program savings in a way that is consistent with the measured HER program savings we need to take into consideration

- When savings start (installation dates)
- When during the year savings actually occur (load shape of yearly savings)
- How long the savings will last (persistence of savings or measure life).

Taking these aspects of energy efficiency program savings into consideration highlights two important characteristics of joint savings.

- Joint savings may last for many years up to the measure life of the specific measure.
- Joint savings increase (or decrease) on a daily basis based on the relative activity in energy efficiency programs between the treatment and control groups.

Nothing has changed in the structure of energy efficiency program savings, but the need to deal with the dynamic nature of joint savings is new. The following scenarios give simplified examples of the practical implications of quantifying savings in this more exacting way.

Consider a scenario where a HER household installs a new lighting system on January 1st, 2009 while a control group household installs the same lighting system on December 31st, 2009. If that system saves 1kwh per day (365kWh per year), the consumption analysis will capture the entire 365 kwh for the HER household and only one kWh for the control household. Therefore, the savings analysis will include 364 kWh due to the lighting program (365 kWh treatment minus 1 kWh control). However, the program tracking data will contain the entire yearly savings estimate for the lighting system in the treatment household and in the control household. Addressing joint savings as a pure difference in participation rates, multiplied by claimed savings, is inconsistent with the consumption analysis because it would assign zero joint savings in this scenario. Therefore, to be correct, joint savings estimates must consider the time of installation.

Consider another scenario where the HER household installs an efficient furnace on June 1st and the control group household installs an efficient furnace on September 1st. This scenario illustrates that the calculation of savings, which must start at the time of installation, must also consider the load shape of savings, or when savings occur during the measurement period. This is done using loads shapes to expand annual savings across the year. In this case, the furnace load shape reflects the fact that furnaces are not used during the summer months and therefore yield no savings during the summer. For this scenario, despite the installation of the HER furnace three months prior than the control furnace, the joint savings are negligible because the HER household furnace is not in use during those three months. In contrast, if the two furnaces were installed January 1st and April 1st, respectively, the joint savings from that period would likely approach half the annual savings for the furnace – this because almost half of the annual usage of furnace takes place during these months.

Finally, consider a scenario where an efficient furnace is installed in a HER household on June 1st and there are no efficient furnaces installed in control group households. In this scenario, all the savings generated by that furnace are joint savings. In the first calendar year, approximately half of the annual savings will count as joint savings (the first part of the heating season up through December 31st). The following year, that furnace will generate a full year of savings. In fact, that furnace will generate joint savings until it is replaced, or from the utilities perspective, until it reaches its measure life.

In reality, both HER program and control households are participating in multiple programs with multiple measures throughout each year for multiple years. The simple two-household scenarios discussed above are repeated thousands of times. They result in an ongoing stream of program savings for HER program households and control group households. The difference between these two streams (HER household savings minus control group savings) represents the joint savings that must be quantified and removed from the estimate of consumption reduction. If the Home Energy Reports have little or no effect on adoption of PSE programs, the difference could be zero or even negative given the natural variability in the two groups[3].

4.2.3 Joint Savings for PSE Programs

The approach for quantifying joint savings depends on whether the PSE program in question is a rebate program or an upstream program. Rebate programs record savings in PSE data tracking systems. The systems track who installed what measures and the date of installation. For upstream programs, such as for CFLs, there is no customer data maintained by PSE due to the program structure (lowering the price at the point of purchase). Who installed the measures and the installation dates are unknown. Section 4.2.3.1 outlines the approach to estimate double counted savings from PSE rebate programs, and section 4.2.3.2 outlines the approach taken to estimate double counted savings from PSE upstream programs.

4.2.3.1 PSE Rebate Programs

Energy efficiency purchases that occur directly through a Puget Sound Energy rebate programs are tracked in PSE data systems. Of particular importance to the analysis of joint program savings, the tracking system includes the measure installed, yearly savings of the measure installed, household addresses for all installed rebate measures, and rebate date. For these purchases, customers receive rebates from Puget Sound Energy and those savings are credited to the PSE program providing the rebate. These programs include clothes washers, energy efficient heating systems, weatherization, etc. In these program data tracking systems, rebate program participation and associated savings are tied directly to the customer within the HER program treatment and control groups. The experimental design framework makes it possible to accurately measure any increased activity in programs by the HER program group.

The joint savings analysis calculates the stream of savings for the HER households and control group households. Savings for all measures start on the day of installation (or rebate date) and are projected forward from that day based on daily load shapes provided by PSE and measure life. At present, the measure lives for all installed measures are greater than the life of the HER program. Therefore, joint savings are savings are debited from the HER program beginning at the date of installation though the end of the three year evaluation. If joint savings continue to

[3] A more detailed explanation of joint savings is contained in a separate memo on joint savings at https://conduitnw.org/Pages/File.aspx?rid=786

be measured in future years, measure savings will continue to be projected forward up to the measure life for that measure.

4.2.3.2 PSE Upstream Programs

Upstream programs support measures with a direct buy down to promote purchases. In the case of CFL bulbs and fixtures, for example, there is a direct buy down resulting in lower prices for consumers at the point of purchase. PSE claims 24 kWh for each CFL bulb purchased through the upstream CFL program, but these savings are not tracked to individual household units[4].

To estimate joint savings associated with the upstream CFL bulb and fixture programs, KEMA utilized customer survey data. The survey was conducted to gather information on the purchase and installation of CFLs for HER program treatment and control groups in calendar year 2011. In particular, survey data on the specific store and location of a respondent's CFL purchase (bulbs or fixtures), combined with the PSE participating retailer data, was used to calculate the number CFLs from PSE participating retailers.

To develop an estimate of upstream program joint savings, KEMA first calculated the number of CFL bulbs and fixtures from participant retailers that were purchased by the HER program households and the control group households. KEMA then calculated the difference in PSE sponsored CFLs between the treatment and control group households. This determined the amount of CFL savings produced by CFLs purchased in 2011. To expand these results to all three years of the program, so as to capture ongoing savings from previous years' upstream CFL joint savings, KEMA assumed these bulbs were all installed on the first day of each program year (November 1st) and the joint savings carried forward on a load shape-weighted basis. The resulting estimates of joint savings for different time periods were then multiplied by the "savings per CFL" value of 24 kWh provided to KEMA by PSE.

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[4] PSE savings claims for upstream CFL are calculated on a per purchased bulb or fixture basis. The estimate of savings incorporates an estimate installation rate. As a result, joint savings for the upstream program is calculated using the relative purchases of program CFLs between treatment and control groups.

4.3 Results

Results of the impact evaluation are first provided for calendar year 2011, followed by results from each of the three program years. These results will be used to support PSE savings claims for the HER Program. Results are also provides for the first three program years to understand program-related savings through the history of the program.

Table 4-1 provides the counts of households in each treatment category that were analyzed during this evaluation.

Table 4-1: Participating HER Households by Report Status and Mailing Frequency

	Monthly	Quarterly	Total
Current	14,128	5,569	19,697
Suspended	6,903	2,771	9,674
Total	21,031	8,340	29,371

Section 4.3.1 provides the overall savings achieved in calendar year 2011. The results include average household and total savings for continued and suspended Report groups as well as total PSE HER savings. Sub-sections discuss each of the components of the overall savings – the measured savings, the rebate program joint savings and the upstream joint savings.

Section 4.3.2 provides additional results across all program years. The remaining sections of the impact results explore the implications of monthly and quarterly mailings for savings, joint savings, and retention of savings after the suspension of the reports.

4.3.1 Calendar year 2011 Savings

Table 4-2 provides the household- and program-level savings for the HER Program for calendar year 2011. These impact results are calculated separately for continued Report households and the suspended Report households, as they represent separate treatment groups. There are three components to household level credited savings:

- **Measured Savings or Consumption reduction** is the average household difference in consumption between HER participants and the control group. It is calculated using a difference-in-differences approach that compares participants and control group consumption in the pre- and post-Report periods. The savings are highly statistically significant for both fuels and both groups. In all cases, the one-sided 95 percent lower confidence interval does not include zero.

- **Rebate program joint savings** represent the increased activity in PSE rebate programs as a result of receiving the Home Energy Report. This is the difference in PSE rebate program savings between the two PSE HER treatment groups (continued Reports and suspended Reports) and the control group.

  The gas rebate program savings are statistically significant for both HER program treatment groups. The rebate program electric savings are not statistically significant for either group. For the current Reports treatment group, the joint savings is negative indicating that the control group has generated slightly more savings than the treatment group.

- **Upstream Program Joint savings** represent the increased use of PSE-supported CFL bulbs and fixtures as a result of receiving the Home Energy Report. This is the difference in PSE upstream program savings between the two PSE HER treatment groups (continued Reports and suspended Reports) and the control group. Joint upstream savings is positive for both groups, but neither estimate is statistically significant.

Table 4-2: Calendar Year 2011 HER Savings

HER Treatment Group	Source	Electric (kWh)		Gas (therms)	
Continued Reports	Per Household Measured Savings	278.4	(241.00 , ∞)	12.9	(10.34 , ∞)
	Per Household Joint Rebate Program Savings	-0.3	(-3.37 , ∞)	1.3	(0.78 , ∞)
	Per Household Joint Upstream Savings	2.3	(-69.72 , ∞)	n/a	
	Per Household Savings, Joint Savings Removed	276.4	(195.38 , ∞)	11.6	(9.05 , ∞)
	Total Group Credited Savings	5,443,983	(3,848,433 , ∞)	228,479	(178,298 , ∞)
Suspended Reports	Per Household Measured Savings	208.1	(159.88 , ∞)	12.0	(8.65 , ∞)
	Per Household Joint Rebate Program Savings	0.5	(-3.52 , ∞)	1.0	(0.34 , ∞)
	Per Household Joint Upstream Savings	43.3	(-22.65 , ∞)	n/a	
	Per Household Savings, Joint Savings Removed	164.3	(82.71 , ∞)	10.9	(7.62 , ∞)
	Total Group Credited Savings	1,589,582	(800,117 , ∞)	105,554	(73,744 , ∞)
Total Program Credited Savings		7,033,565	(4,866,495 , ∞)	334,033	(267,373 , ∞)

These components are combined regardless of whether the joint savings components are statistically significant individually. For average per household credited electric savings, rebate and upstream joint savings are subtracted from the measured savings derived by the consumption analysis. For average per household credited gas savings, rebate joint savings are subtracted from the measure savings derived by the consumption analysis. Per household credited savings are expanded to the full populations for the continued and suspended Report groups using the counts from section 4.3. Total program savings are the combination of the continued and suspended Report group savings.

Table 4-3 summarizes the HER program results with respect to average consumption. The continued treatment group produced credited savings at 2.6 and 1.3 percent for electric and gas, respectively. The suspended treatment group produced credited at 1.6 and 1.2 percent, for electric and gas, respectively.

Table 4-3: Calendar Year 2011 HER Savings
Credited Savings (Joint Savings Removed) as a Percent of Consumption

Her Treatment Group	Electric			Gas		
	Consumption*	kWh	Percent	Consumption*	kWh	Percent
Continued Reports	10,596	276.4	2.6%	920	11.6	1.3%
Suspended Reports		164.3	1.6%		10.9	1.2%

*Control Group calendar year 2011 consumption

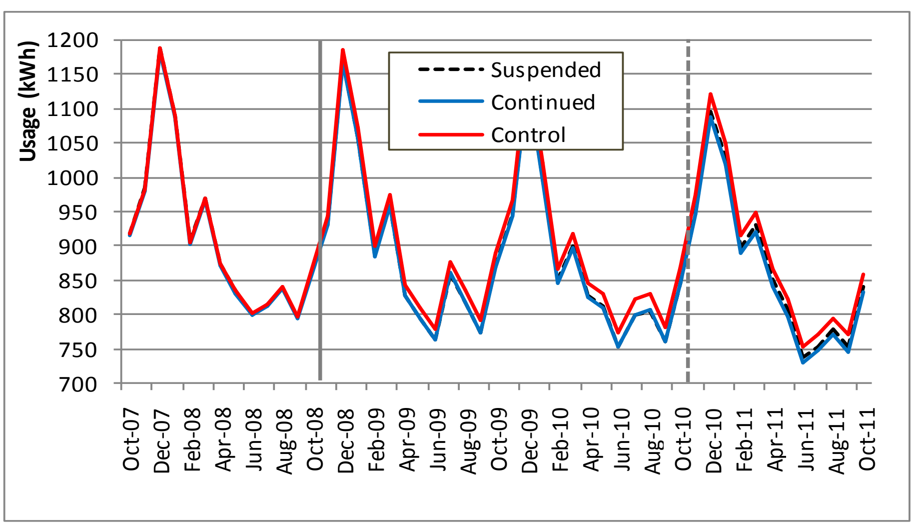
4.3.1.1 HER Program Measured Savings

Measure Savings represents the difference in consumption between the HER program treatment groups and the control group. The following figures are designed to put 2011 measured savings into the context of measured consumption through the three years of the program.

4.3.1.1.1 Treatment and Control group Consumption

Figure 4-1shows electric consumption starting a year prior to the Program period (up to October 2008) and covering the first three years of the Program thereafter. The first year displayed in the figure (October, 2007 to October 2008), is the pre-Program period. In this period the treatment and control groups are expected to be statistically identical and they appear effectively identical in the plot.

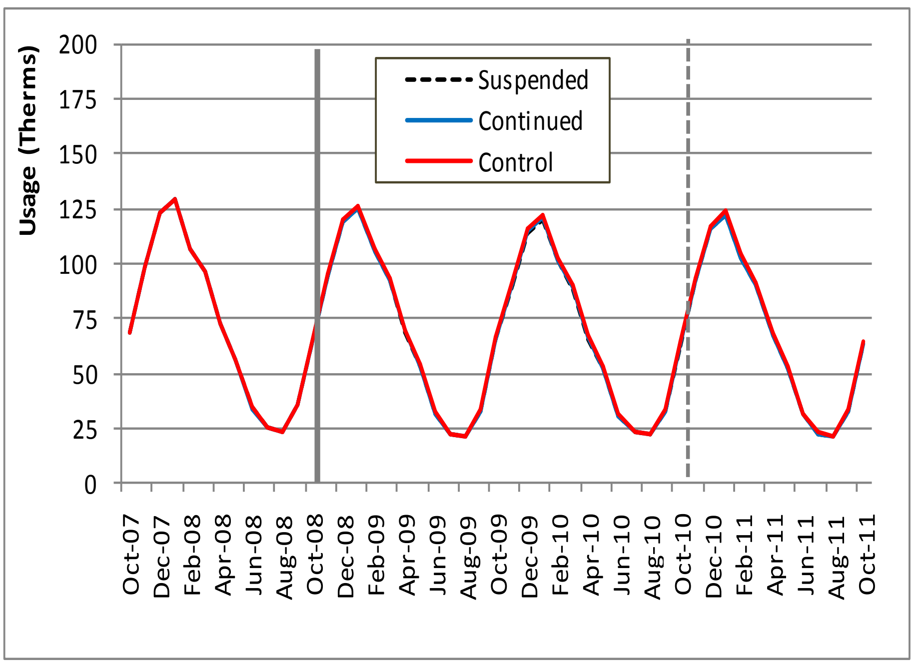
Figure 4-1: Monthly Electric Consumption
Control Group and Continued and Suspended Treatment Groups



After October, 2008, the control group consumption is clearly higher than treatment group consumption in every month. Continued and suspended treatment groups are statistically identical through this period. After October 2010, the suspended Report treatment group came into existence. As expected, the suspended Report treatment group consumption is higher than the continued Report treatment group, moving upwards slightly toward the control group consumption.

Figure 4-2 shows the same plot for gas consumption. It shows gas consumption starting a year prior to the Program period (up to October 2008) and covering the first three years of the Program thereafter. The transition to the lower HER program-related consumption for the treatment groups is more difficult to illustrate in the gas figure because gas savings is a smaller percent of consumption and gas consumption varies so much from month to month range of the Y-axis must be wide. The figure does, however, illustrate gas consumption for typical control and treatment groups.

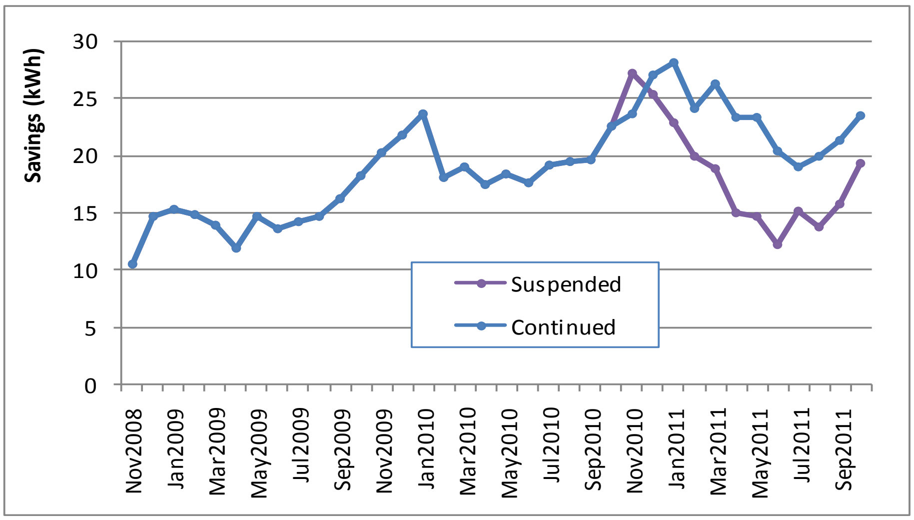
Figure 4-2: Monthly Gas Consumption
Control Group and Continued and Suspended Treatment Groups



4.3.1.1.2 Monthly measured savings

Figure 4-3 provides a plot of the measured savings for continued and suspended treatment groups. The plot captures the differences in consumption between the treatment and control groups illustrated in Figure 4-1 during the program period. All report recipients are in the continued treatment group for the first two years. The suspended group is plotted separately after October, 2010. The program savings are statistically significantly different than zero across all months. Year over year, there is an increase in savings through all three years of reported savings.

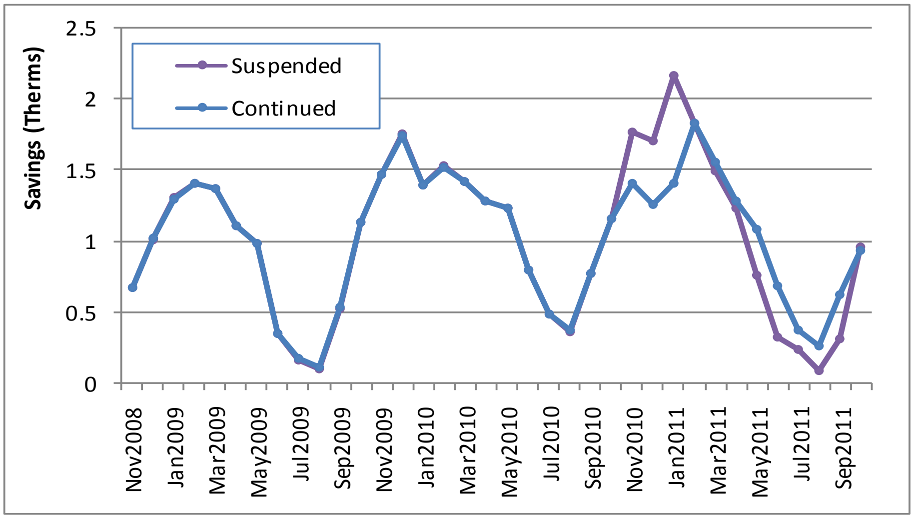
Figure 4-3: Monthly Electric Measured Savings



The monthly savings estimates diverge in November 2010 reflecting the subset of treatment households for which the mailing of Reports was suspended. On an annual basis, the third year difference between the continued and suspended Reports group's savings are statistically significant (Section 4.3.1.1.3). .

Figure 4-4 provides a plot of the monthly difference in therm consumption between the treatment and control groups. Once again, all report recipients are in the continued treatment group for the first two years. The suspended group is plotted separately after October, 2010. As with consumption, the measured savings is highly seasonal.

Figure 4-4: Monthly Gas Measured Savings

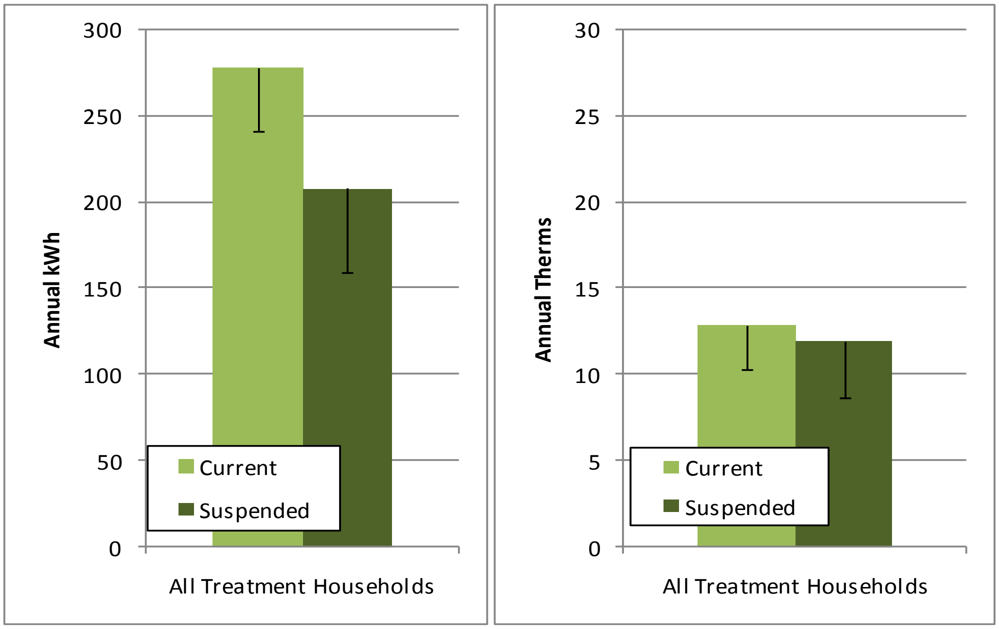


The program savings are statistically significantly different than zero across most months. During the summer periods both gas consumption and savings are lower and as a result the difference from zero is also smaller.

4.3.1.1.3 Continued vs Suspended Reports Annual Savings

Figure 4-5 summarizes the calendar year 2011 measured savings for the continued and suspended treatment groups. Savings for both the suspended and continued report groups are significantly different than zero, using a 95 percent one-tail test.

Figure 4-5: Average Annual Savings Continued vs. Suspended Treatment Groups



On the electric side, the savings for the suspended group are approximately 25% lower than those of the continued group, and the savings between those two groups is statistically significant at the 95% level. Although suspended households saved 7% fewer therms in 2011 than the homes which continued to receive reports, there is no statistical difference in gas savings between the suspended and continued groups in 2011.

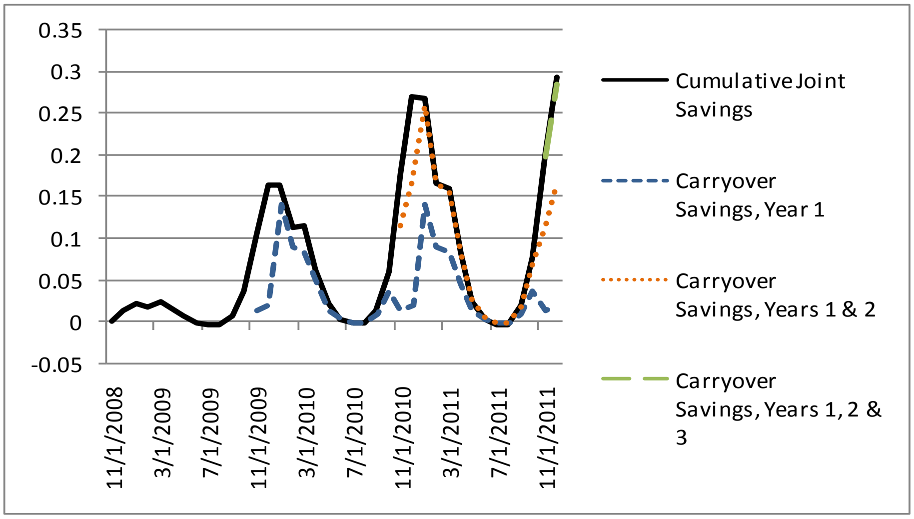
4.3.1.2 2011 Program Joint Savings

4.3.1.2.1 PSE Rebate Program Joint Savings

As discussed in section 4.2.3.1, joint savings are the difference between the dynamic flows of savings from the treatment and control groups. These plots are designed to illustrate the ongoing flow of savings over time. Where the underlying dynamic is simple, (eg. consistently increasing savings), these plots are relatively easy to understand. Where the savings are more variable, the visual representation is more challenging to interpret.

Joint gas savings for the continued treatment group have increased consistently and thus provide a relatively simple plot of the savings flows. Figure 4-6 provides monthly gas joint savings for the continued reports treatment group.

Figure 4-6: Monthly Gas Joint Savings for the Continued Reports Treatment Group



The solid black line traces the total monthly joint savings over the first three years and two months of the program. During the first year of the program, the monthly joint savings line only reflects the joint savings generated by measures installed during the first year of the program. After the first year, those first year measures continue to produce savings for each of the subsequent years, as captured by the blue dashed line and referred to as carryover savings. The first year savings (solid line in the first year) are less than the subsequent year carryover savings (blue dashed line) because the measures were installed throughout the year and the relative levels of installation in the treatment and control groups. For this plot, first year joint savings are fixed after the end of the first year. Those first year joint savings have a monthly load shape and will generate those savings until reaching their measure lives.

Table 4-4 provides the associated annual breakouts of joint savings. The joint savings in the first year only amounted to 0.15 therms per household because of when the occurred. On a full year basis, those first year savings represented 0.45 therms per household and those savings are carried forward for each year through the timeframe of the is evaluation.

Table 4-4: Annual Gas Joint Savings for the Continued Reports Treatment Group

Period	Cumulative Joint Savings	Carryover Savings, Year 1	Carryover Savings, Years 1 & 2
PY1	0.15		
PY2	0.83	0.45	
PY3	1.25	0.45	1.06
2011	1.30	0.45	1.06

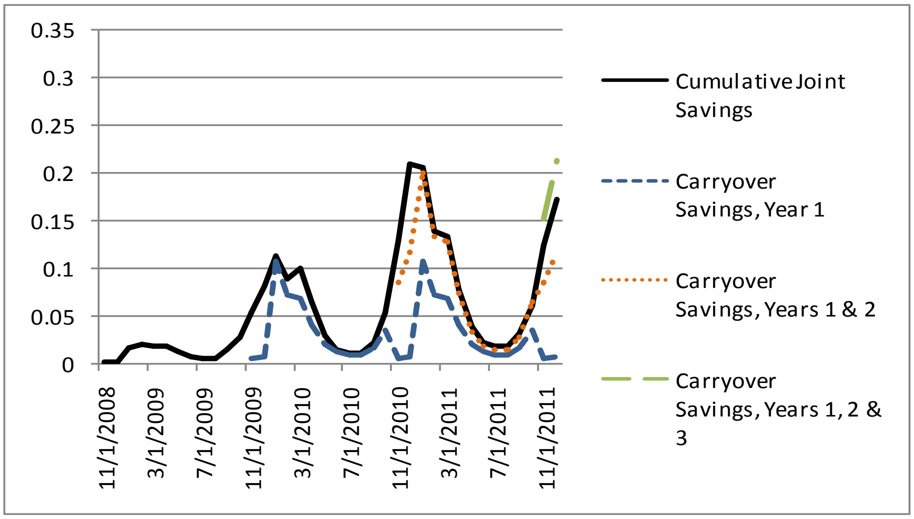
In the second year of the program, still more additional measures were installed by the treatment group. The increase from the carryover first year savings (blue dashed line) to the cumulative joint savings (solid black line) shows the joint savings from the additional measures installed in the second year. These second year joint savings will also carry forward into the third year. The carryover from first and second year savings combined are represented by the dotted orange line.

In annual terms, total joint savings in year two was 0.83 therms per household. Of that, 0.45 was carryover from year one. In the third year, first and second year carryover savings represented 0.45 and 0.61 therms per household, respectively, or a total carryover savings of 1.06 therms per household.

Figure 4-6 nicely illustrates the way joint savings carry forward. When additional joints savings are generated every year, the prior year joint savings provide the baseline from which additional savings grow.

Figure 4-7 shows the same gas joint savings plot for the suspended treatment group. While this plot is, as expected, similar to the previous plot for the first two years, the magnitude of savings is smaller than that of the continued savings group through the period. These differences are not statistically significant but make it difficult to identify lower savings as the effects of the suspension of Reports in the third year.

Figure 4-7: Monthly Gas Joint Savings for the Suspended Reports Treatment Group



The last two months of the plot provide some suggestive evidence that joint savings are dropping for the suspended treatment group. The total monthly joint savings (solid black line) drops below the expected carryover from the first three years of joint savings (dashed green). This indicates that, during this period, joint savings are actually dropping indicating greater control group than suspended treatment group program activity.

Table 4-5 gives the annual gas joint savings for suspended treatment group.

Table 4-5: Annual Gas Joint Savings for the Suspended Reports Treatment Group

Period	Cumulative Joint Savings	Carryover Savings, Year 1	Carryover Savings, Years 1 & 2
PY1	0.15		
PY2	0.64	0.40	
PY3	1.09	0.40	0.91
2011	1.04	0.40	0.91

The electric joint savings plots (Figure 4-8 and Figure 4-9) and annual joint savings results (Table 4-6 and Table 4-7) illustrate the lack of meaningful electric joint savings. There is no clear trend in savings and scale is extremely small at a fraction of a kWh.

Figure 4-8: Monthly Electric Joint Savings for the Continued Reports Treatment Group

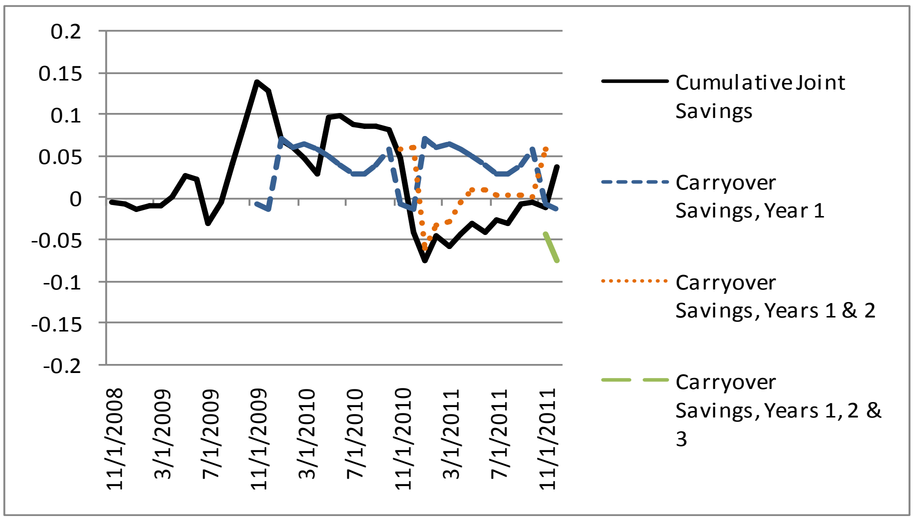


Table 4-6: Annual Electric Joint Savings for the Continued Reports Treatment Group

Period	Cumulative Joint Savings	Carryover Savings, Year 1	Carryover Savings, Years 1 & 2
PY1	0.10		
PY2	1.01	0.48	
PY3	-0.36	0.48	0.02
2011	-0.34	0.48	0.02

Figure 4-9 : Monthly Electric Joint Savings for the Suspended Reports Treatment Group

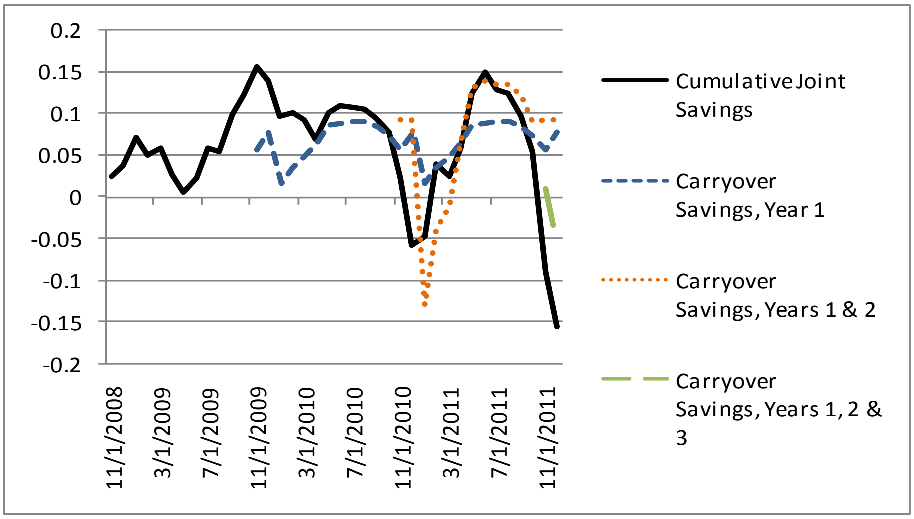


Table 4-7: Annual Electric Joint Savings for the Suspended Reports Treatment Group

Period	Cumulative Joint Savings	Carryover Savings, Year 1	Carryover Savings, Years 1 & 2
PY1	0.63		
PY2	1.25	0.82	
PY3	0.72	0.82	0.83
2011	0.51	0.82	0.83

4.3.1.2.2 PSE Upstream Programs

Table 4-8 provides the estimates of CFL purchases for the survey sample of the continued report treatment and the control group households. The difference between the savings resulting from participation in the CFL program, between the continued group and the control group, is a fraction of a single light bulb. The number of CFL fixtures purchased or installed was small compared to CFL bulbs; though, in terms of percentages, the differences are bigger. None of the differences are statistically significantly different from zero.

Table 4-8: Continued Report Treatment Group CFL Bulb and Fixture Counts

Average # per household	Control Group	Current Treatment Group	Joint Bulbs or Fixtures (T - C)	Confidence Interval*
Program CFL Bulbs				
Purchased	5.97	5.94	-0.03	(-0.97 , ∞)
Installed	4.01	4.12	0.12	(-0.55 , ∞)
Total CFL Bulbs				
Purchased	7.22	7.22	0.00	(-0.98 , ∞)
Installed	4.85	5.00	0.15	(-0.55 , ∞)
Program CFL Fixtures				
Purchased	0.09	0.15	0.06	(-0.08 , ∞)
Installed	0.08	0.09	0.01	(-0.08 , ∞)
Total CFL Fixtures				
Purchased	0.17	0.20	0.03	(-0.13 , ∞)
Installed	0.14	0.14	0.00	(-0.12 , ∞)

Survey Responses: Control Group counts range from 443 to 488; Continued Participant counts,from 336 to 365

The key values are difference in the purchased CFL bulb and fixtures. PSE upstream savings are assigned per purchased bulb which means the 24 kWh value already incorporates an implied installation rate. Because installation and location are challenging information for a survey recipient to provide, we report results for purchased and installed and for both program-supported and for all bulbs and fixtures. The results are consistent across purchased and installed bulbs as well as program-supported and all bulbs.

Table 4-9 provides the same results for the suspended treatment group. The estimate of upstream joint savings is actually higher than for the suspended group. Though, consistent with the continued treatment group findings, none of the results for the suspended group were statistically different than zero.

Table 4-9: Suspended Report Treatment Group CFL Bulb and Fixture Counts

Average # per household	Control Group	Suspended Treatment Group	Joint Bulbs or Fixtures (S - C)	Confidence Interval*
Program CFL Bulbs				
Purchased	5.97	6.54	0.57	(-0.30 , ∞)
Installed	4.01	4.48	0.47	(-0.16 , ∞)
Total CFL Bulbs				
Purchased	7.22	7.61	0.40	(-0.51 , ∞)
Installed	4.85	5.24	0.39	(-0.29 , ∞)
Program CFL Fixtures				
Purchased	0.09	0.09	0.00	(0.00 , ∞)
Installed	0.08	0.08	0.00	(-0.08 , ∞)
Total CFL Fixtures				
Purchased	0.17	0.13	-0.04	(-0.14 , ∞)
Installed	0.14	0.12	-0.02	(-0.11 , ∞)

Survey Responses: Control Group counts range from 443 to 488; Suspended Participant counts,from 442 to 485

These findings represent savings of CFLs installed during calendar year 2011. From the survey data, we know when during the year CFLs were purchased. To simulate CFL joint savings through the program period, we must expand 2011 savings to all program years. To do this we assume that all CFLs were purchased on the first day of the program year, and that purchases have been steady each year the program period.

This approach implies a constant but lo-level trend, and is supported by the pattern of joint savings produced by the electric rebate program. Electric joint savings have remained very small with no apparent trend through the duration of the program.

4.3.2 Yearly Program Results

This section uses results from the site-level modeling approach to compare HER savings across the three years of the program, using weather normalized data. These figures remove the effects of weather thus making it possible to discern trends across the three years.

Figure 4-10 shows the normalized consumption reduction of households receiving the Report across the three years of the HER program. The first two years include the full HER treatment group. Only the continue Report group is included for year three. All three years for both gas and electric are clearly statistically different from zero.

Figure 4-10: Normalized Measured Savings over Three Program Years

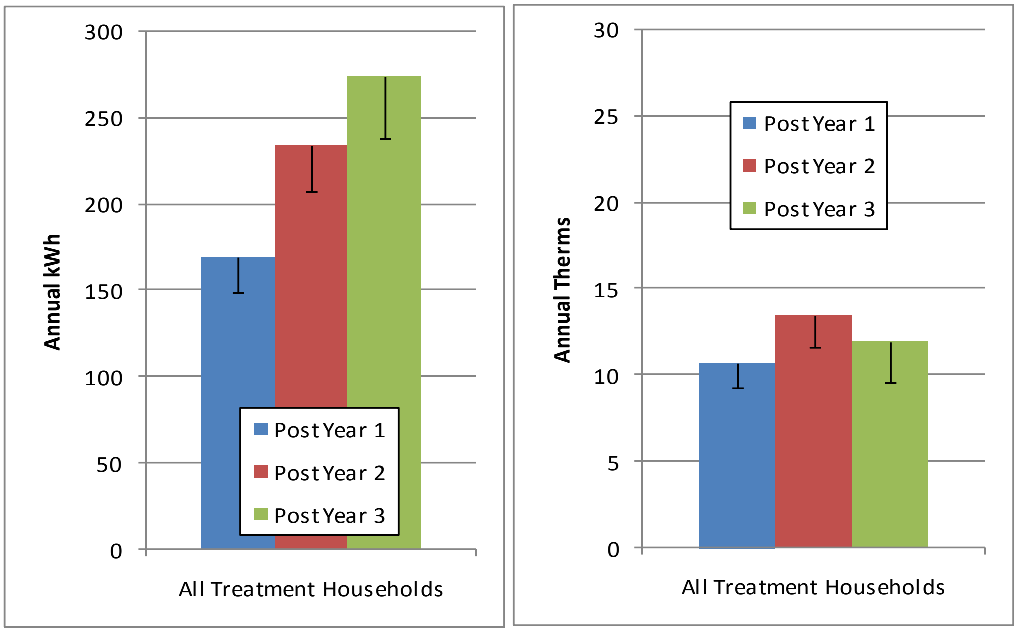


Figure 4-10 illustrates the change from year to year over the three years of the program. Electric measured savings show a clear upward trend across the three years with an apparent slowing down in the increase from year two to year three. Statistical significance tests are not able to confirm all of these observations. The difference between the first and second year is statistically significant at a 95 percent confidence level. This is not the case for the difference between the second and third year [5]. The real question is at what level will electric savings level off.

Gas savings demonstrate a less dramatic trend than electric savings. The decrease between years two and three is small and not statistically significant. However this could indicate that HER related gas savings have already reached a plateau.

[5] In addition to the smaller increment, the standard errors are higher for year three because of the split of the treatment group into continued and suspended Report groups.

Figure 4-11 shows the third year results from Figure 4-10 and adds the estimated consumption reduction of the suspended Report households. Electric estimates suggest a downward trend while the gas estimates do not, though neither of these differences is statistically significant.

Figure 4-11: Normalized Consumption Reduction, Continued vs Suspended Reports

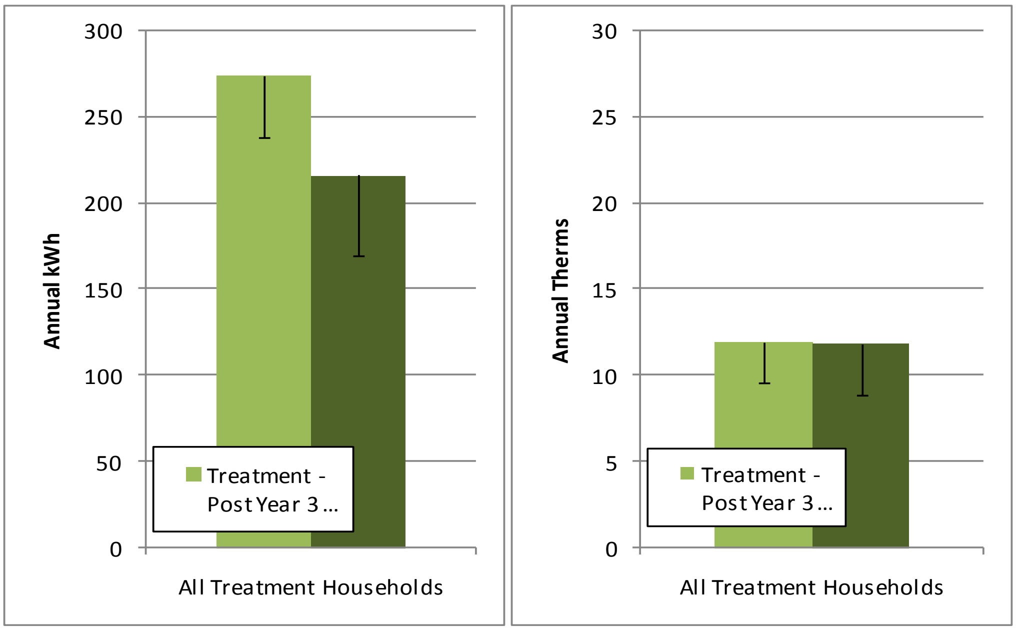


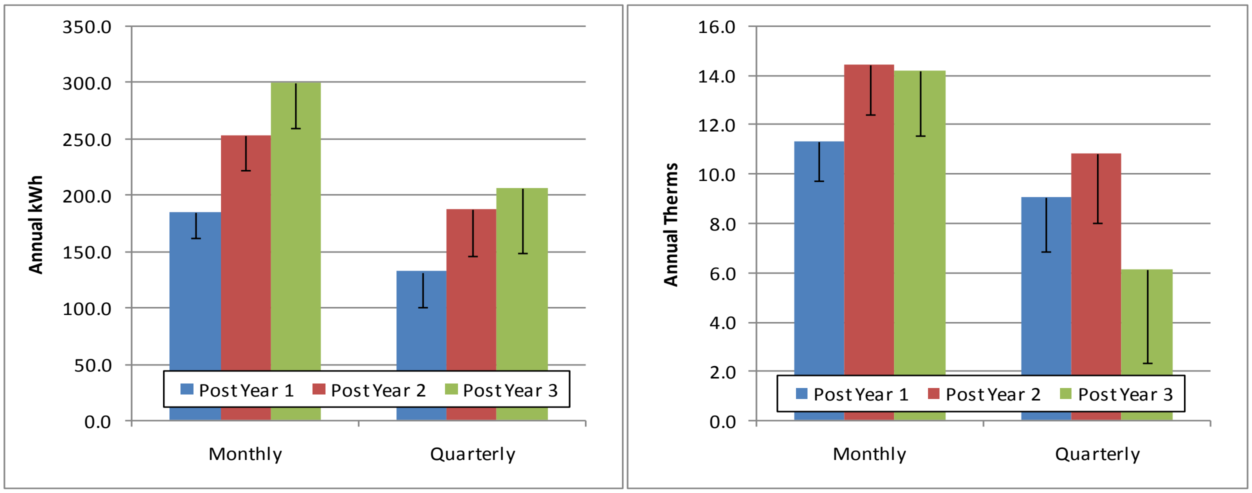
Table 4-10 provides the tabular results for that last two figures. Confidence intervals are one-side, 95 percent confidence intervals.

Table 4-10: PSE HER Program per Household Weather Normalized Savings

Year and Group	Electric (kWh)	Therms (therms)
Year 1	169.7 (149.70 , ∞)	10.7 (9.27 , ∞)
Year2	234.5 (207.25 , ∞)	13.5 (11.61 , ∞)
Year 3 - Continued	274.2 (238.01 , ∞)	11.9 (9.59 , ∞)
Year 3- Suspended	216.4 (169.77 , ∞)	11.9 (8.85 , ∞)

Figure 4-12 provides the same results as Figure 4-10, but separates the consumption reduction estimates for households that received monthly and quarterly reports. The separate monthly and quarterly year results are still individually statistically significant. These figures also illustrate the different savings levels over the three years for monthly and quarterly reports for each fuel. For measured electric savings, the quarterly HER group savings are lower than the monthly HER groups savings for all three years. These differences are statistically significant at a 95 percent confidence level. Quarterly Report group measured gas savings are also consistently lower than the monthly Report group savings. For gas savings, only the difference in year three is statistically significant.

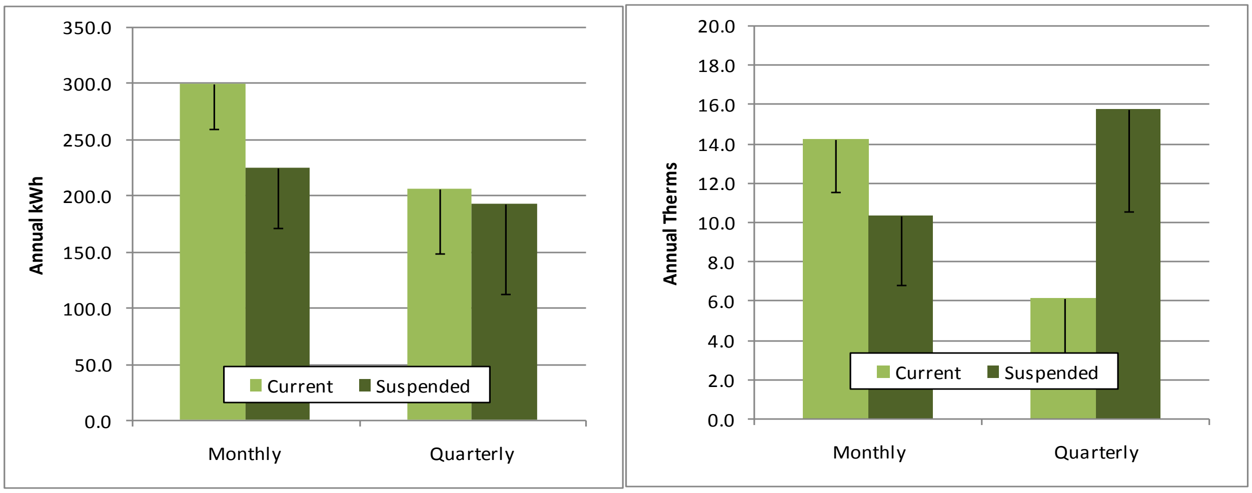
Figure 4-12: Normalized Consumption Reduction over Three Program Years, Monthly vs Quarterly



Looking past statistical significance at point estimate trends offers some tentative insights. In addition to the general reduction in savings, it appears that the change over time may also differ. The rate of increase in electricity consumption reduction for quarterly Report households appears to be slowing compared to the monthly Report households. Gas consumption reduction remained steady in the third year for households receiving monthly Reports and dropped by a statistically significant margin in the third year for households receiving Quarterly Reports.

Figure 4-13 provides the third year results for both electric and gas with the suspended treatment household results included. The electricity measured savings results generally conform to expectation, with suspended treatment households generating fewer savings than continued treatment households. The monthly report household difference is statistically significant at the 90 confidence level. Though the quarterly electric difference is not statistically significant, the decrease in quarterly report household savings is smaller than the decrease for monthly report household savings. It is not surprising that quarterly report household have greater staying power in the short run, because those savings were established with less frequent treatment all along. If the quarterly report households continue to maintain savings levels in the second year of suspended reports, relative to the monthly report households, this will bolster the overall cost-effectiveness of the quarterly reports approach.

Figure 4-13: Normalized Consumption Reduction In Year 3 Continued vs Suspended Reports, Monthly vs Quarterly



The monthly gas results are similar to the electric monthly results. The reduction is savings is not statistically significant but shows an approximately 30 percent reduction. The quarterly gas results appear anomalous and are also not statistically significant. The quarterly suspended treatment group is relative small which may explain the unexpected result.

Table 4-11 provides the tabular results for that last two figures. Confidence intervals are one-side, 95 percent confidence intervals.

Table 4-11: PSE HER Program per Household Weather Normalized Savings, Monthly and Quarterly Reports

Report Frequency	Year and Group	Electric (kWh)		Gas (therms)	
Monthly	Year 1	184.6	(184.58 , ∞)	11.3	(11.32 , ∞)
	Year2	253.0	(253.03 , ∞)	14.5	(14.49 , ∞)
	Year 3 - Continued	300.6	(300.64 , ∞)	14.2	(14.23 , ∞)
	Year 3- Suspended	225.7	(225.73 , ∞)	10.3	(10.32 , ∞)
Quarterly	Year 1	132.3	(132.26 , ∞)	9.1	(9.07 , ∞)
	Year2	187.9	(187.90 , ∞)	10.9	(10.86 , ∞)
	Year 3 - Continued	207.0	(206.96 , ∞)	6.1	(6.13 , ∞)
	Year 3- Suspended	193.3	(193.33 , ∞)	15.8	(15.77 , ∞)

4.3.3 Impact Results Summary

The impact results are summarized separately for calendar year 2011 and for the three year program evaluation.

4.3.3.1 Calendar Year 2011 Impact Results Summary

Both continued and suspended treatment groups generated statistically significant energy savings in calendar year 2011. Table 4-12 summarizes the household level measured savings generated by the HER program and the savings credited to the program after removing joint savings claimed by other PSE programs.

Table 4-12: Calendar Year 2011 PSE HER Program per Household Savings Estimates

HER Treatment Group	Source	Electric (kWh)	Gas (therms)
Continued Reports	Measured Savings	278.4 (241.00 , ∞)	12.9 (10.34 , ∞)
	Credited Savings	276.4 (195.38 , ∞)	11.6 (9.05 , ∞)
Suspended Reports	Measured Savings	208.1 (159.88 , ∞)	12.0 (8.65 , ∞)
	Credited Savings	164.3 (82.71 , ∞)	10.9 (7.62 , ∞)

Table 4-13 summarizes the HER program results with respect to average consumption for participating households. The continued treatment group produced credited savings at 2.6 and 1.3 percent for electric and gas, respectively. The suspended treatment group produced credited at 1.6 and 1.2 percent, for electric and gas, respectively.

Table 4-13: Calendar Year 2011 PSE HER Credited Savings (Joint Savings Removed) as a Percent of Consumption

Her Treatment Group	Electric			Gas		
	Consumption*	kWh	Percent	Consumption*	kWh	Percent
Continued Reports	10,596	276.4	2.6%	920	11.6	1.3%
Suspended Reports		164.3	1.6%		10.9	1.2%

*Control Group calendar year 2011 consumption

Table 4-14 summarizes the total program savings for all households in the two treatment groups and for the full program.

Table 4-14: Calendar Year 2011 Final PSE HER Overall Program Credited Savings Estimates

HER Treatment Group	Source	Electric (kWh)	Gas (therms)
Continued Reports	Total Group Credited Savings	5,443,983 (3,848,433 , ∞)	228,479 (178,298 , ∞)
Suspended Reports	Total Group Credited Savings	1,589,582 (800,117 , ∞)	105,554 (73,744 , ∞)
Total Program Credited Savings		7,033,565 (4,866,495 , ∞)	334,033 (267,373 , ∞)

Other calendar year 2011 findings:

- Table 1-2 reports the relative levels of continued and suspended treatment group saving for both measured and credited savings.
    - For measured savings suspension of reports resulted in a decrease in savings of 25 and 7 percent for electric and gas, respectively. The electric difference was statistically significant while the gas difference was not.
    - For credited savings, the suspension of reports resulted in a decrease in credited savings (measured savings with joint savings removed) of 41 and 6 percent for electric and gas, respectively. Neither of these differences was statistically significant due to the additional variability from the incorporation of the joint savings estimates
- The HER Reports increased savings produced by gas measures from rebate programs. For the continued group, 10 percent of measured savings was due to participation in other PSE programs. For the suspended group, 9 percent of the measured savings was due to participation in other program. Both gas joint savings estimates were statistically significant. Neither electric joint savings estimate was statistically significant.
- The HER Reports did not increase savings produced by electric measures from rebate programs. Less than one percent of measured savings was due to participation in other PSE programs for both treatment groups. Neither estimate was statistically significant.
- Upstream CFL program joint savings were not statistically significant. Survey results indicated that suspended treatment households purchased about a half bulb more of

program CFLs than the control households. Expanded to three years, this amounted to 43 kWh in joint savings for the upstream CFL programs for this group. Upstream joint savings was only 2 kWh for the continued treatment group.

4.3.3.2 Three Year Impact Evaluation Findings

The PSE HER Program generated statistically significant savings for all three years. The suspended group, which did not receive reports in year three continued to generate savings even without the report.

The weather normalized electric results show savings increasing each year, although the savings appear to be increasing at a slower rate between years two and three. Weather normalized gas results show gas savings increasing from year one to year two but dropping slightly in the third year.

The normalized, third year results indicate a more moderate effect of suspension of the reports on savings. Suspending Home Energy Reports lowered measured savings in the first year post suspension by 21 and 0 percent for electric and gas, respectively. The electric result was statistically significant. The difference between these results and the 2011 results is primarily explained by the different time period. The third year results look at the first 12 months of report suspension (November, 2010 to October, 2011), whereas the 2011 results look at months three through thirteen.

The three year impact evaluation also considered the differences between monthly and quarterly mailings across the three year. Less frequent quarterly reports continue to generate fewer savings than monthly reports in the third year. In addition, visual evidence suggests that the quarterly reports may also level out and/or decline sooner than the monthly reports. When reports were suspended, households receiving monthly reports reduced electric savings more than household receiving quarterly reports. Gas results were inconclusive.

5. Behavioral and Process Evaluation

The behavioral and process evaluation examined the nature and extent of the influence of the Home Energy Reports on household energy-related purchases and behaviors, through a customer survey. The principal research objectives were to:

- Assess effects of the HER program on self-reported purchase/installation of energy efficient equipment or measures, with a focus on non-program purchases[6].
- Assess effects of the HER program on household energy saving behaviors
- Assess customer response to HER reports.

The behavioral and process evaluation leverages the extensive customer surveys that were required to quantify the upstream program joint savings for the impact evaluation. The behavioral portion of the survey expands the attempt to quantify upstream joint savings to the full range of energy-related behaviors. At the highest level, the behavioral and process evaluation attempts to answer the question, “Where do HER Program savings come from?”

The survey, performed early in the fourth program year, asked respondents about purchases and behaviors that took place during the preceding year, approximately calendar year 2011. This limited timeframe for the survey questions was necessary for the sake of respondent recall. As the results are developed, it’s important to remember the limited one year timeframe in the program’s third year. By the third year of a HER-type program, savings are generally starting to level off. Purchases and behaviors that produced the savings may also be leveling off, or alternatively, becoming unremarkable. This makes it more difficult to distinguish purchases and behaviors in general and more difficult to establish whether the responses truly represent the actions that produced the savings.

[6] With the exception of CFL bulbs and fixtures, PSE tracking data was used to identify installations of efficient equipment inside of PSE programs. Therefore, the survey focused on non-program purchases and installations as well as installation and purchases of CFLs and Fixtures inside of PSE programs.

5.1 Overview of Approach

To address the Behavioral and Process evaluation objectives, KEMA conducted a customer survey of households from the HER Program, as described in section 3.1.2. In the analysis of survey data, we compared the survey responses across the following groups of households:

- **Control group** (never received Home Energy Reports)
- **Continued treatment group** (received Reports continuously since start of program)
- **Suspended treatment group** (received Reports in Year 1 and Year 2 but stopped receiving that at start of Year 3)

The evaluation team compared the continued treatment group to the control group to assess differences in household purchases and behaviors associated with ongoing receipt of the Home Energy Reports. We also compared the suspended treatment group to the control group to assess whether there are sustained effects after the reports are discontinued. Finally, where relevant, we note the differences between the continued and suspended report groups. In general, the continued and suspended groups represent two different levels of treatment. Because both groups continued to generate savings in year three and because of the general challenge of establishing any link between purchases/behaviors and savings, the first step is identify whether either group shows evidence of purchases and behaviors that support the observed savings.

Consistent with the research objectives, analysis of survey data is organized into the following sections:

- **Energy efficient purchases** (Section 5.2) – Distinct actions involving payment of money for an item that have an associated stream of energy savings resulting from that single action.
- **Energy related behaviors** (Section 5.3), including**:**
    - **Measure-related behaviors** -- Actions or installations with a measure specific component, which may add a degree of persistence to the behavior (e.g. “insulate hot water pipes”).
    - **Energy saving behaviors** -- Ongoing behavioral choices (e.g. “regularly turn down heat at night”).
- **Response to Home Energy Reports** (Section 5.4)

This section also looks at differences in the level of non-energy efficient purchases as well as whether purchases were replacement of existing measures or additional purchases. These results combine with the energy-efficiency related purchase data to give a more refined picture of the effect of energy-related behaviors on energy consumption. A key finding is that consumer behavior is more than a matter of choices between options (energy efficient or not). It may be just as much about the choice of whether to purchase at all.

5.2 Energy Efficient Purchases

This section reports the findings of the survey research regarding the question as to whether HER participants purchased more energy efficient measures outside of rebate programs than the control group.. This is a key hypothesis regarding how HER participants generate savings. It is particularly important because of the implications for the retention of savings with or without the reports. Equally important, understanding retention of savings due to hard measure installations allow us to more easily understand persistence of savings from behaviors.

In addition to discussing household purchases, this section will discuss the effect of replacing old energy-related equipment with new equipment versus the addition of a completely new energy-related measure on household consumption. Replacing existing measures with even a standard efficiency unit can generate substantial savings. This is particularly true for some of the higher energy using measures in the household like furnaces and refrigerators. The improvements in standard efficiency units are such that simply an increase in the replacement rate among HER program participants would generate savings. On the other hand, additional measures, whether energy efficient or not, will increase household consumption effectively undermining savings. Electronic purchases are the best example of this scenario. Additional TVs and computers will increase household consumption whether they are energy efficient or not.

5.2.1 Approach

To examine the influence of the HER program on household decisions to purchase or install energy efficiency measures, we compared differences between continued treatment, suspended treatment and control groups in the proportion of households reporting the purchase/installation of specific energy-using equipment and energy efficiency measures. For each item, the survey asked whether the item purchased/installed was PSE rebated energy efficient equipment, a non-program (non-rebated) energy efficient measure, or something else (i.e. not identified as energy efficient). We examined the frequency of these three outcomes across the three groups.

In addition, for key measures we asked if a non-energy efficient measure purchase was a replacement or additional purchase.

Table 5-1 presents the list of measures which were asked about during the survey, by measure type.[7]

Table 5-1: Measures Included in Purchase/Installation Analysis

Measure Type	Specific Measures Examined
Heating and Cooling	Furnace, boiler, Central air conditioner, Room air conditioner, Air source heat pump, Geothermal heat pump, Ductless heat pump
Water Heater	Storage tank water heater, Tankless water heater
Appliances	Refrigerator, Freezer, Clothes washer, Clothes dryer, Dishwasher, Dehumidifier
Consumer Electronics	Television, Computer, Computer monitor, Digital video recorder (DVR)
Insulation	Attic insulation, Wall insulation, Floor insulation, Insulation of ducts in unheated spaces

To make the overall length of the survey feasible, not all respondents were asked all questions. The following table summarizes the number of completed surveys for each area.

Table 5-2: Survey Complete Counts for Measure Categories

Survey Section	Continued Treatment	Suspended Treatment	Control
CFL (All)	373	494	502
Heating	220	259	254
Cooling	211	240	255
Lighting (non-CFL)	229	233	256
Water Heating	229	233	256
Appliance	244	256	239
Electronics	229	233	256

[7] The analysis of CFL purchases is presented in the Impact Evaluation results.

The survey asked respondents to report on purchases or installations of energy efficient equipment during calendar year 2011.

5.2.2 Results

Figure 5-1 provides a high-level summary of measure category results. Relative results are presented on left side of the figure and absolute results are presented on the right side.

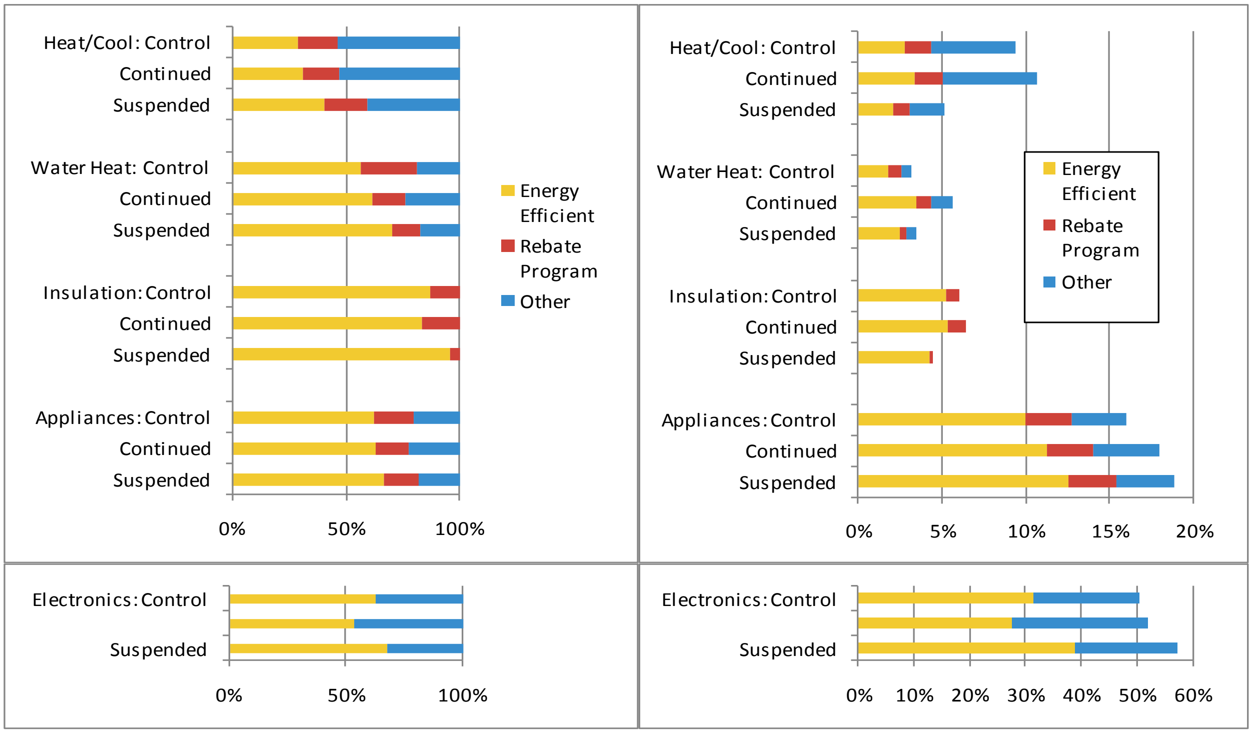
- The results are grouped by measure category (heat/cool, water heat, etc). The three analysis groups (control, continued Reports, and suspended Reports) are represented for each measure category.

- The relative results illustrate the breakout into purchase categories for all households **that made a purchase**. Purchases were put into three categories: energy efficient through a PSE rebate program, energy efficient not through a rebate program, and other, non-energy efficient. We refer to these as percentage of purchasing households

- The absolute results show the same data with the actual percentages of households that purchased any measure (whole bar) along with the category breakouts (colors). We refer to these as percentage of all (group) households.

This figure is designed to provide high-level summaries without tests for statistical significance. The key results with tests for statistical significance are provided following the discussion of this figure.

Figure 5-1: Energy Efficient Purchases
Summary of Relative and Absolute Measure Type-Level Results



The relative and absolute results both provide a perspective on the data that is instructive. The relative results facilitate comparing category breakouts across the different analysis groups. Across all the measure-type categories, the continued group only exhibits a clear increase over the control group in the water heater category. Interestingly, the suspended group shows an increase over control for almost every measure category.

The absolute results display the percent of purchasing household results in the context of the overall data. This is the perspective that is probably more relevant to the generation of savings. The bars and colors indicate the actual magnitude of the purchases within the group. In most instances, more energy efficient measures will generate more savings, even if they are a smaller percentage of the overall measure purchases. This distinction highlights the importance of two further considerations:

- Is a measure is a replacement or additional unit, and
- If it is a replacement, what is the relative efficiency of standard efficiency replacement versus the existing measure?

Purchases of heating and cooling measures provide a good example of these issues. The relative results seem to indicate the suspended and continued treatment groups are similar with respect to the breakout to different purchase types. The absolute results show that there was half as much activity among suspended group households across all three kinds of purchases compared to either the control or continued treatment group. Despite a similar percentage of purchasing households opting for energy efficient measures, the suspended group likely generated less savings relative to the control group because of the lower level of measure category purchasing activity.

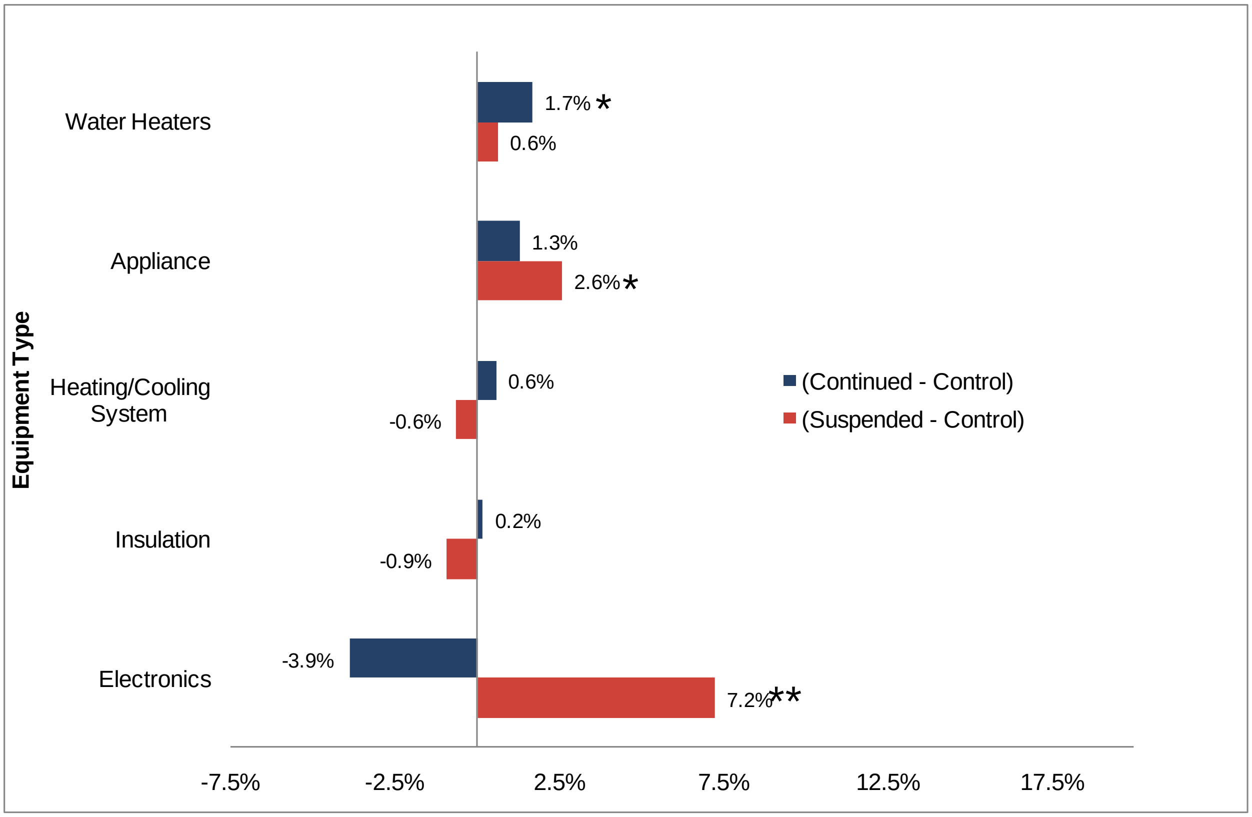
This should be particularly true in the heating-related category because most furnaces are replacements (rather than additional) and standard efficiency furnace replacements generally offer improved efficiency compared to most existing furnaces. The non-energy efficient furnaces will generate savings at a lower rate (lower savings per unit). However, a greater amount of activity in any of the three purchase categories should generate savings when considering furnaces.

Across all the categories, there is more variability across the different groups with regard to the absolute level of the three purchase activities than with regard to the relative share of the three purchase activities among purchasers. The results in the next section, where we focus on the results for which the difference between treatment (either continued or suspended) and control is statistically significant, support this conclusion. Statistically significant results indicate an effect that is distinguishable given the size of the survey sample.

5.2.2.1 Purchases by Measure Category

Figure 5-2 provides the difference in purchases of non-program energy efficient measures between the two treatment groups and the control group from Figure 5-1(yellow bars). These results all come from the absolute results in Figure 5-1 – percent of households overall. None of the associated percent of purchaser results (relative results) were statistically significant.

Figure 5-2: Non-program, Energy Efficient Purchases Treatment group Differences by Measure Category



At the measure-category level, the only statistically significant difference between continued treatment and control groups is the higher rate of purchases of energy efficient water heating equipment. There are two statistically significant differences between suspended treatment and control groups – the higher rate of purchase of energy efficient appliances and electronics. Table 5-3 provides the actual treatment and control percentages, the differences and the associated P-value. The three P-values with confidence exceeding one-sided 95 percent statistical significance (< 0.05) are shaded dark gray in the P-value column.

Table 5-3 :Non-program, Energy Efficient Purchases
Treatment group Differences by Measure Category

Treatment Group	Measure Category	Control (C)	Treatment Continued (T)	HER Related Uptake (T - C)	P-Value
Continued	Water Heaters	1.8%	3.5%	1.7%	0.06
	Appliance	10.0%	11.3%	1.3%	0.27
	Heating/Cooling System	2.7%	3.3%	0.6%	0.33
	Insulation	5.2%	5.4%	0.2%	0.45
	Electronics	31.5%	27.6%	-3.9%	0.83
Suspended	Water Heaters	1.8%	2.4%	0.6%	0.24
	Appliance	10.0%	12.6%	2.6%	0.10
	Heating/Cooling System	2.7%	2.1%	-0.6%	0.73
	Insulation	5.2%	4.3%	-0.9%	0.76
	Electronics	31.5%	38.8%	7.2%	0.04

As discussed above, the implications of these results are informed by whether the purchases were replacements of existing measures or additional measures. The only statistically significant result relating to additional purchases was in the electronics category. The continued treatment group made substantially fewer additional electronic purchases than the control group (18.6 percent for continued treatment group compared to 25.4 percent for the control group). The suspended treatment group, on the other hand, made more purchases that were additional relative to the control group. These data combine to suggest a different interpretation of the purchase decision results in Table 5-3. The continued treatment group was less likely to purchase energy efficient electronics, but was also less likely to purchase additional measures. In balance, they may have saved relative to the control group because new electronic purchases did not increase consumption because they were replacements. Similarly, the suspended treatment group was more likely to buy energy efficient electronics, but those purchases were also more likely to be additional purchases increasing electric consumption in the household. This example highlights the challenge of connecting behavior change back to specific changes in consumption at the household.

5.2.2.2 Purchase of Individual Measures

The aggregate measure level results summarize purchase patterns across a range of individual measures within the category. The survey analysis of individual measure purchases shows statistically significant higher rate of purchases for only 3 of the 23 individual measures for both the continued treatment group and the suspended treatment group compared to the control group. Purchases significant at a 90 percent, one-tailed level were included in this group. Table 5-4 lists these results.

Table 5-4: Non-Program, Energy Efficient Purchases
Specific Measures Items with Statistically Significant Treatment Group Differences

Treatment Group	Individual Items	Control (C)	Treatment Continued (T)	HER Related Uptake (T - C)	P-Value
Continued	Water heater with storage tank	1.6%	3.2%	1.6%	0.06
	Clothes Washer	0.8%	2.1%	1.3%	0.05
	Attic Insulation	1.4%	3.5%	2.1%	0.02
Suspended	Clothes Washer	0.8%	3.2%	2.4%	0.00
	TV	16.0%	22.5%	6.4%	0.03
	Computer	16.0%	21.4%	5.4%	0.05

When we restrict the analysis to purchasers, as opposed to all members of the group, we find no statistically significant differences between treatment and control groups in the rate of energy efficient non-rebated purchases in the five broad measure categories or for any of the 23 individual measures.

5.2.2.3 Self-reported Rebate Purchases

We looked at the self-reported purchases of energy efficient equipment through PSE rebate programs and found no evidence of increased PSE rebate program purchases in the treatment group relative to the control group. The survey-based differences between treatment and control groups in self-reported PSE rebate program purchases are both positive and negative and are not statistically significant across all measure categories and both gas and electric. This is consistent with the electric results of the analysis of PSE rebate program tracking data as presented in the Impact Evaluation. The gas joint savings analysis showed some increase in year three of the program, but it was small and would not necessarily be distinguishable with the present sample sizes.

5.2.2.4 Non-Energy Efficient Purchases

As discussed earlier, there are situations where non-energy efficient purchases could result in energy savings when they replace existing equipment. When they are non-replacements, they would result in increased consumption.

Table 5-5 provides measure category-level results for non-energy efficient purchases. The only statistically significant difference between either of the treatment group and the control group was continued treatment group electronics. Furthermore, this difference was significant at only the 90 percent, one-sided level. This parallels the result shown above in Table 5-2 where the continued treatment group installed fewer energy efficient electronics (though the result was not statistically significant).

Table 5-5: Non-Energy Efficient Purchases
Treatment group Differences by Measure Category

Treatment Group	Individual Items	Control (C)	Treatment Continued (T)	HER Related Uptake (T - C)	P-Value
Continued	Water Heaters	0.6%	1.3%	0.7%	0.13
	Appliance	3.2%	4.0%	0.8%	0.25
	Heating/Cooling System	5.0%	5.6%	0.6%	0.36
	Insulation				
	Electronics	19.0%	24.3%	5.3%	0.08
Suspended	Water Heaters	0.6%	0.6%	0.0%	0.49
	Appliance	3.2%	3.4%	0.3%	0.41
	Heating/Cooling System	5.0%	2.1%	-2.9%	0.99
	Insulation				
	Electronics	19.0%	18.6%	-0.4%	0.55

The survey data indicates three statistically significant increases in the purchase of specific non-energy efficient measures for the continued group and one for the suspended group. Table 5-6 provides these results.

Table 5-6: Non-Energy Efficient Purchases
Specific Measures Items with Statistically Significant Treatment Group Differences

Treatment Group	Individual Items	Control (C)	Treatment Continued (T)	HER Related Uptake (T - C)	P-Value
Continued	Air source heat pump	0.2%	1.3%	1.1%	0.04
	Dishwasher	0.4%	1.3%	0.9%	0.06
	TV	7.2%	11.0%	3.8%	0.07
Suspended	Dishwasher	0.4%	1.2%	0.8%	0.07

Both treatment groups purchased more non-energy efficient dishwashers than the control group. All of the dishwashers were replacements, however, so it's unlikely that this finding affected consumption substantially in either direction.

The increase in continued group, non-energy efficient TVs has already been discussed in the context of the electronics category group. However, TVs, as a specific measure, are not less likely to be additional purchases for continued group than the control group. These results point to an increase in TV-related electric consumption for the continued group.

The increase in air-source heat pumps is more challenging to evaluate with respect to energy consumption. A heat pump may replace some other form of heating (gas or electric), some form of cooling (central or room AC) both or neither. The counts are too small to explore this results further.

5.2.2.5 Energy Efficient Purchases Findings

These results, in combination, paint a mixed picture of the effect of the HER program on the purchase of energy efficient measures outside of rebate programs. There are relatively few statistically significant increases in purchases of energy efficient measures. There is no apparent pattern in the non-significant results. Overall, there is no evidence in these results that increased purchases of energy efficient measures in 2011 explained a substantial portion of the overall estimated HER Program savings.

The statistically significant results that we did find are absolute differences, differences in the percentage of energy efficient purchases as a percentage of all households, rather than relative differences, difference in the percentage of energy efficient purchases of those who made purchases. These results reflect different levels of purchase activity across the groups rather than different allocations of purchases to energy efficient measures.

This indicates that the absolute level of activity overall is as important a focus as the relative level of difference purchase types. This conclusion is further enhanced by recognizing that, for measures with low adoption rates, it is relatively more difficult to attain statistical significance for results that are an absolute percentage of all household than the relative percentage of purchasers. This further highlights the presence of only absolute, statistically significant results.

This section also discussed the difference between purchases that replace other measures and those purchases that are additions to the household stock. In this context, energy efficient purchases that are additions to the household stock may actually decrease household-level savings. At the same time, in a replacement scenario, even non-efficient installations have the potential to generate savings as shown by the example of the standard efficiency furnace. These results remind us that consumer behavior is not just a matter of choices between options (energy efficient or not) but whether or when to purchase at all. This is particularly important to consider given that these results indicate that absolute levels of purchases vary more than relative breakouts.

If surveys are repeated in the future, it might be worth gathering greater sample sizes so as to generate more statistically significant results. It's unclear from the results from this evaluation whether greater sample sizes will reveal more clear patterns of purchase decisions between the two treatment groups and the control group with regard to either absolute or relative purchase decisions. This could be a result of the taking place in the fourth year of the program. In the early years of a program, HER participants may be more active in their response to the Reports as well be better able to identify differences in purchase behavior.

5.3 Energy Related Behaviors

5.3.1 Approach

For the energy saving and measure-related behavior analysis, the analysis of the survey data focused on whether receiving Home Energy Reports is associated with a higher incidence of self-reported behaviors to reduce energy usage within the household. Table 5-7 presents the list of behaviors which were asked about during the survey,

Table 5-7: Energy-Related Behaviors

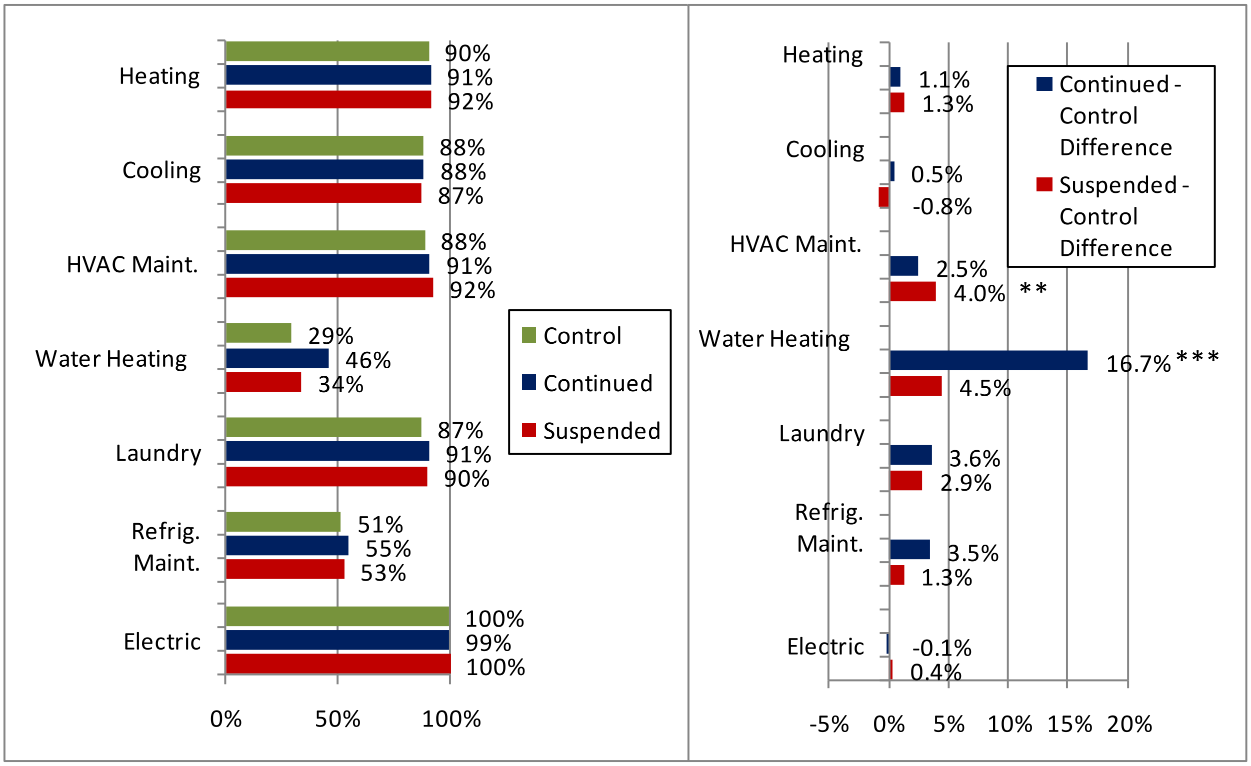
Category	Behavior
Water heating	Turn down water temp when away 2+ days
	Keep WH at lower temp setting
Laundry	Wash clothes in cold water
	Hand dry laundry
	Use dryer moisture sensor
Refrigerator maintenance	Tighten refrigerator seal
	Clean refrigerator coils
HVAC maintenance	Clean/replace air filters on heating system
	Professional heating system maintenance
	Clean area around window AC
Heating behaviors	Turn down heat at night
	Turn down heat daytime unoccupied
	Run ceiling fans reverse in winter
	Turn down tstat when running fireplace
Cooling behaviors	Regularly use ceiling fan
	Regularly close shades in summer
	Turn off AC when unoccupied
	Keep doors/windows closed when AC on
Electronics behaviors	Manually turn off power strips
	Use smart power strips
	Regularly unplug electronics when idle
	Use computer power-save mode
	Turn off computer at night
	Regularly turn off lights

To test the effect of increased uptake of energy saving behaviors resulting from HER, KEMA compared the proportion of respondents in the continued treatment, suspended treatment and control groups who answered yes to one or more of the behaviors listed in Table 5-7.

5.3.2 Energy Saving Behaviors

Figure 5-3 provides the energy saving behavior results at the category level. The percentages in the left panel reflect the number of households that reported at least one of the specific behaviors in that category. Most of the categories show a high level activity among all three groups. In all categories other than water heating, the variation between groups is small compared to the level of activity.

Figure 5-3: Energy Saving Behaviors
Activity Levels and Treatment Group Differences



The right panel focuses on the differences between the two treatment groups and the control group. Those differences are expanded and, in two instances, marked to indicate statistical significance. Overall, the energy savings behaviors are more consistent than the energy efficient purchases results. The treatment groups showed an increase in energy saving behaviors for all but two of the fourteen comparisons across the two treatment groups. The continued treatment group shows a greater difference in more than half of the categories. While only two differences reached the level of statistical significance, there is a general pattern that indicates a general HER Program-related increase in energy savings behaviors.

The survey analysis of individual behaviors, as opposed to composite groups of behaviors, only one showed statistically significant differences in uptake between the continued treatment and control groups. Specifically, a greater proportion of the treatment group reported keeping their water heater at a lower temperature (11% difference, significant at the 95% confidence level). Comparing differences between the suspended and control groups for individual behaviors, the suspended group (92%) was more likely than the control group (87%) to say they regularly changed their heating system's air filters.

5.3.3 Measure Related Behaviors

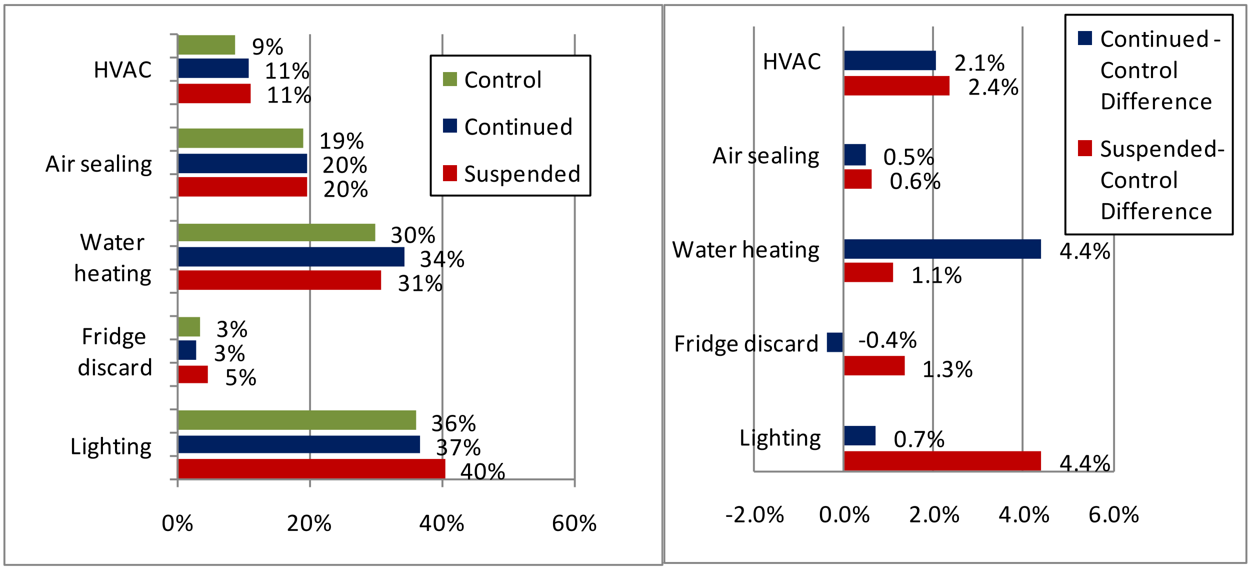
For the measure-related behavior analysis, the analysis of the survey data focused on whether receiving Home Energy Reports was associated with a higher incidence of self-reported behaviors to reduce energy usage that involved more permanent, measure-related changes. Table 5-8 presents the list of measure-related behaviors which were asked about during the survey.

Table 5-8: Measure-Related Behaviors

Category	Behavior
Water heating measures	Insulate hot water pipes
	Install low flow showerheads
HVAC measures	Seal leaky ducts
	Install fireplace insert
	Install ceiling fan
Air sealing	Install storm windows
	Improve fireplace sealing
	Seal area around window AC
Refrigerator discard (non-rebated)	Non-rebated refrigerator discard
	Non-rebated freezer discard
Lighting measures	Install outdoor motion detectors
	Install outdoor solar lights
	Install LED lights

Figure 5-4 presents the survey results for measure-related behavior in the same format as the energy saving behavior results in the previous section. The left panel plots the percentage of households adopting at least one specific measure-related behavior within the category. The adoption rate of these measure-related behaviors is substantially lower than the energy savings behaviors and more variable across the different categories. Once again, the apparent differences between the two treatment groups and the control are small relative to the level of adoption. The right panel expands the differences evident in the left panel. Once again, the trend is more consistent than the energy efficient purchases results. All but one of the ten differences across the two treatment groups are positive. The suspended treatment group has higher adoption of the measure-related behaviors than the continued treatment group in 4 of the 5 categories. None of the results for measure-related behaviors are statistically significant.

Figure 5-4: Measure-related Behaviors: Activity Levels and Treatment Group Differences



When KEMA examined the differences between the suspended and control groups for individual measure related behaviors, one achieved statistical significance. The suspended group (3%) was more likely than the control group (1%) to say they installed and used a fireplace insert.

5.3.4 Summary

Energy saving Behaviors and measure related behavior results are more consistently positive than the energy efficient purchases results, though there are still only a handful of statistically significant results.

Given the survey results presented here, the observed consumption reduction of the treatment groups appears to be the cumulative effect of a number of small differences. The small differences may be too small to observe individually without impractically large samples, but

There are at least two other hypotheses than need to be considered as possible explanation for the indeterminate behavioral survey results.

Timing of the survey --These behavioral surveys were fielded in the fourth year after participants started receiving Home Energy Reports. Out of necessity, they focused on the actions respondents took during the prior year. It is possible that many of the energy efficiency purchases, energy saving behaviors or measure-related behaviors that account for continued HER-related energy savings occurred in the first or second year of the program. The surveys would not identify energy efficiency purchases and measure-related behaviors that occurred in the first or second year of the program. Even behaviors (lowering of heating set points) that were established within the first two years might not register as differences by the third year.

Measurement Distortion Caused by Home Energy Reports -- It's possible that the receiving of Home Energy Reports may distort the way continued or suspended treatment respondents answered the questions. The Home Energy Reports are designed to increase participants' awareness of home energy use, and this increased awareness could affect the way participants answered questions. It is plausible that increased awareness could push the results in either direction – towards greater or lesser differences with the control groups. For example, increased awareness might create a social desirability effect where treatment/suspended participants over-report their energy-saving behaviors. On the other hand, it is possible that respondents in the control group overstate their energy-saving behaviors because they do not know as much about the subject. At this point, it is impossible to measure if or how the Home Energy Reports distorted participants' answers.

To improve the survey results, it is essential to increase the effective sample size supporting the estimates. This can be achieved by simplifying and shortening the survey as well as increasing the targets. Developing an exhaustive list of possible behaviors and action with non-statistically significant results is not useful. Focusing the results on the most likely sources of savings and maximizing the likelihood of achieving statistically significant results may describe a more limited set of potential savings more effectively.

5.4 Response to Home Energy Reports

After completion of the survey questions related to purchases and behaviors, all of the continued and suspended treatment group survey respondents were asked a series of questions about their recollection and use of the Home Energy Reports. Section 5.4 of this report provides a summary of these results.

This section highlights the recollection and use of the Home Energy Reports by the treatment condition.

5.4.1 Recollection of Reports

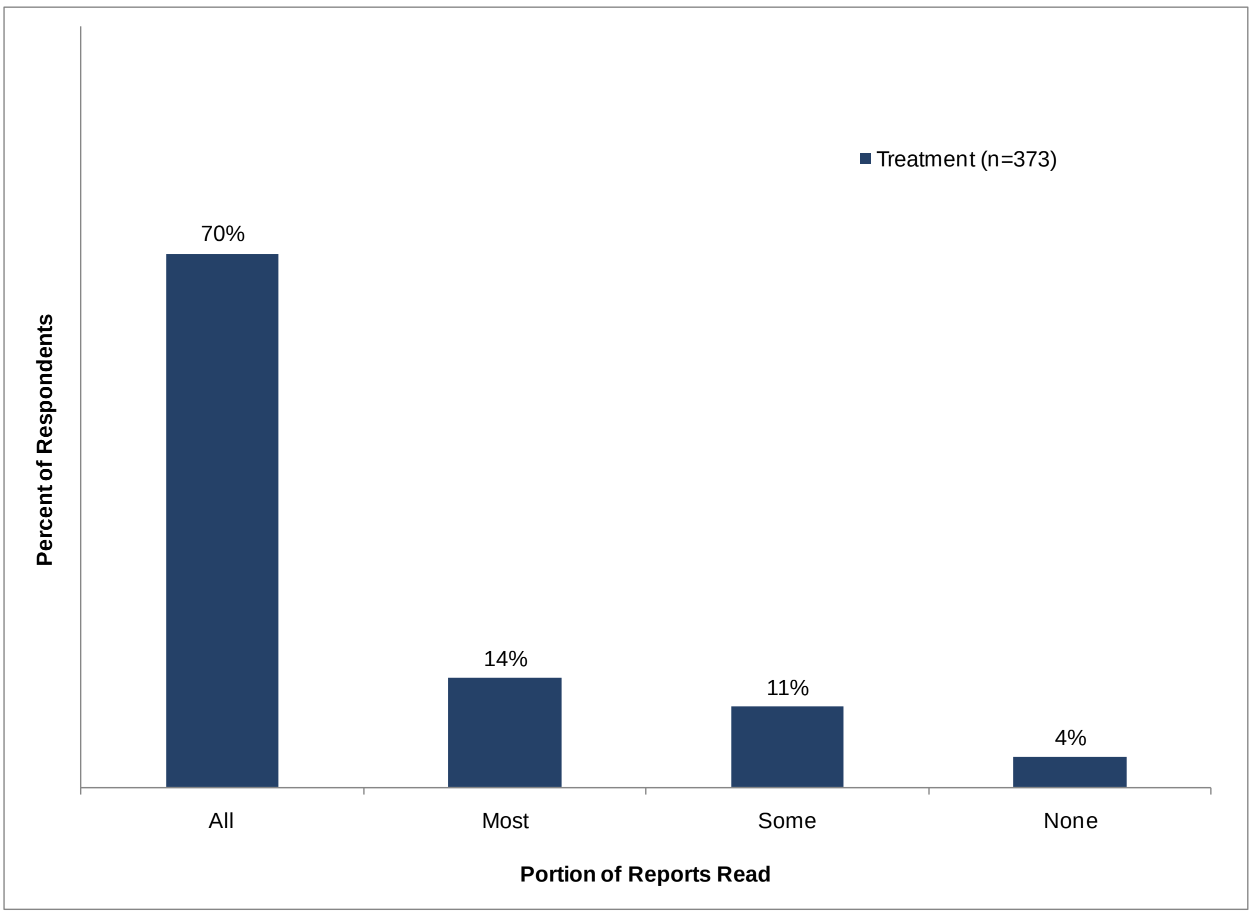
The survey asked respondents if they remembered receiving reports from Puget Sound Energy about their in-home energy use. Almost all of the treatment condition (92%) said they remembered the reports. For any respondent who said they did not remember the reports, the survey included a follow-up question that provided a brief description of the reports. It then gave the respondents a second chance to say whether they remembered the report. Most of the treatment group (74%) said they remembered the reports after getting the description. Overall, 98 percent of the treatment condition remembered the reports.

Only respondents who remembered receiving the reports in one of these two questions were asked the remaining questions in this section of the survey.

5.4.2 Use of Reports

The survey asked a series of questions to assess how often someone in the respondent’s household read the reports. About three-fourths (70%) of the treatment condition said they read every report (Figure 5-5).

Figure 5-5: Portion of Reports Read



There were several statistically significant differences in the reported portions of reports read depending on whether the respondents who received monthly or quarterly reports, number of household residents, and the presence of children (Table 5-9).

- *Report frequency:* Monthly recipients were more likely than quarterly to say they read every report. Conversely, quarterly recipients were more likely than monthly to say they read some of the reports. Note, these differences may be caused by the difference in report receipt frequency affecting respondents' memory or the way they answer this question.
- *Number of residents:* Households with two or fewer residents were more likely than those with three or more residents to say they read every report.
- *Children:* Households without children were more likely than those with children to say they read every report. Note, there is likely a substantial amount of overlap among these latter two categories – households with children are likely to also have three or more residents.

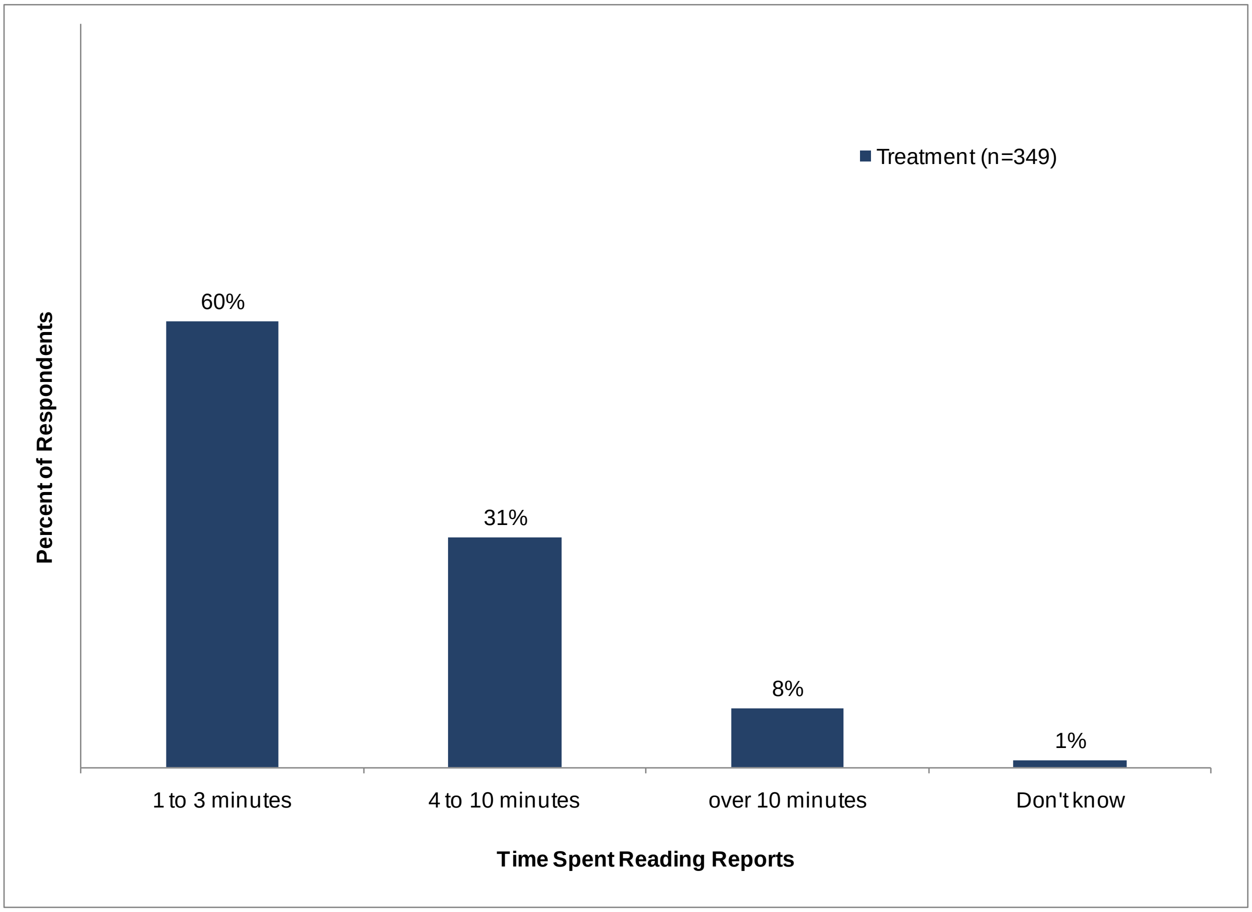
Table 5-9: Portion of Reports Read Categorical Differences

Categories		Portion of Reports Read		
		All	Most	Some
Report Frequency	Monthly (n=268)	10%	14%	77%
	Quarterly (n=105)	16%	19%	65%
	sig.	*		**
Number residents	2 or less (n=177)	81%	14%	5%
	3 or more (n=171)	65%	16%	19%
	sig.	**		**
Children	no children (n=230)	78%	15%	7%
	children (n=119)	64%	16%	20%
	sig.	**		**

* Difference statistically significant at 90% confidence level.
** Difference statistically significant at 95% confidence level.

About two-thirds (60%) of the households which indicated they read at least some of the reports said they spent one to three minutes on the reports. Another 31 percent said they spent four to ten minutes reading the reports (Figure 5-6).

Figure 5-6: Time Spent Reading Reports



There were several statistically significant differences in the reported time spent reading reports depending on whether the respondents who received monthly or quarterly reports, number of household residents, education, and whether they discussed the reports with household members (Table 5-10).

- *Report frequency:* Quarterly recipients spent more time reading the reports than monthly recipients. Quarterly recipients were more likely than monthly recipients to report spending over 10 minutes or four to 10 minutes reading the reports, and less likely to say they spent one to three minutes reading the reports.

- *Number of residents:* Households with three or more residents were more likely than those with fewer residents to say they spent over 10 minutes on the reports and less likely to spend four to ten minutes on the reports.

- *Education:* Respondents with four-year college degrees were more likely than those with less education to say they spent one to three minutes on the reports.

- *Discussed reports:* Respondents who shared the reports with household members spent a little more time reading the reports than those who did not share the reports with household members. Respondents who discussed their home's energy use with household members were more likely than those who did not discuss energy use with the household to spend four to ten minutes on the report and less likely to spend one to three minutes.

Table 5-10: Time Spent Reading Reports Categorical Differences

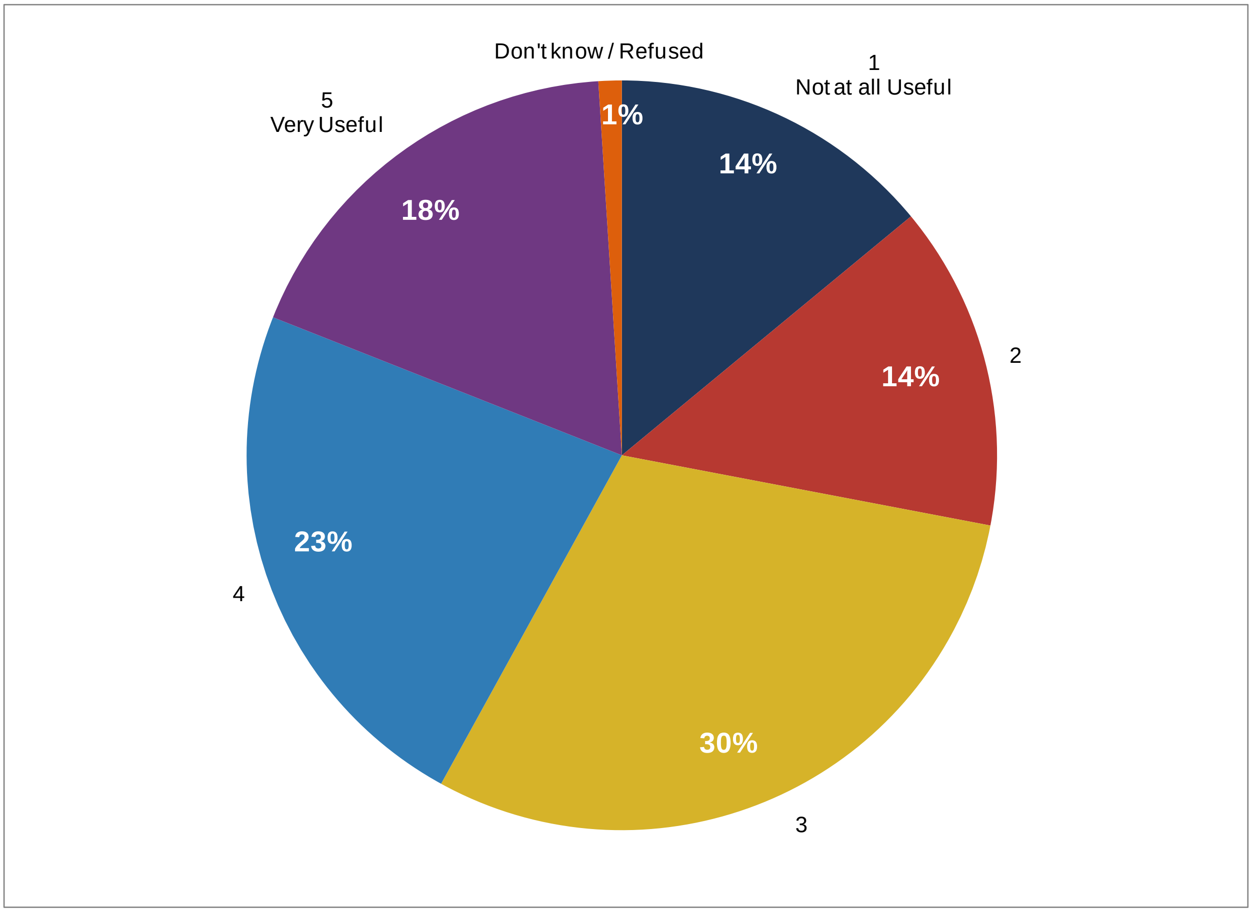
Categories		Time Spent Reading Reports		
		1 to 3 min	4 to 10 min	>10 min
Report Frequency	Monthly (n=268)	66%	28%	7%
	Quarterly (n=105)	49%	39%	12%
	sig.	**	**	*
Number residents	2 or less (n=177)	58%	36%	6%
	3 or more (n=171)	63%	25%	11%
	sig.		**	*
Education	Less than 4yr degree (n=133)	55%	33%	11%
	4 yr college degree (n=117)	68%	25%	7%
	sig.	**		
Discussed Report with Household	No (n=85)	72%	19%	7%
	Yes (n=263)	57%	35%	8%
	sig.	**	**	

* Difference statistically significant at 90% confidence level.
** Difference statistically significant at 95% confidence level.

5.4.3 Usefulness of Reports

Respondents rated the usefulness of the reports on a five-point scale anchored at 1 for "not at all useful" and 5 for "very useful." The results of this question are reported in Figure 5-7. Quarterly report recipients had similar usefulness ratings as monthly recipients.

Figure 5-7: Usefulness of Reports



There were several statistically significant differences depending on the number of household residents and respondent education (Table 5-11).

- *Number of residents:* Respondents with three or more household residents were more likely than those with fewer residents to give a rating of 1 on the five-point scale. Respondents with more household members may feel as though they have less control over their household's energy use than those with fewer members.

- *Education:* Respondents with four-year college degrees found the reports less useful than those with graduate training. Respondents with four-year college degrees were more likely than those with graduate training to give a rating of 1 and less likely to give a rating of 4. Respondents with more education may have more practice reading and interpreting data, and thus find the reports more useful.

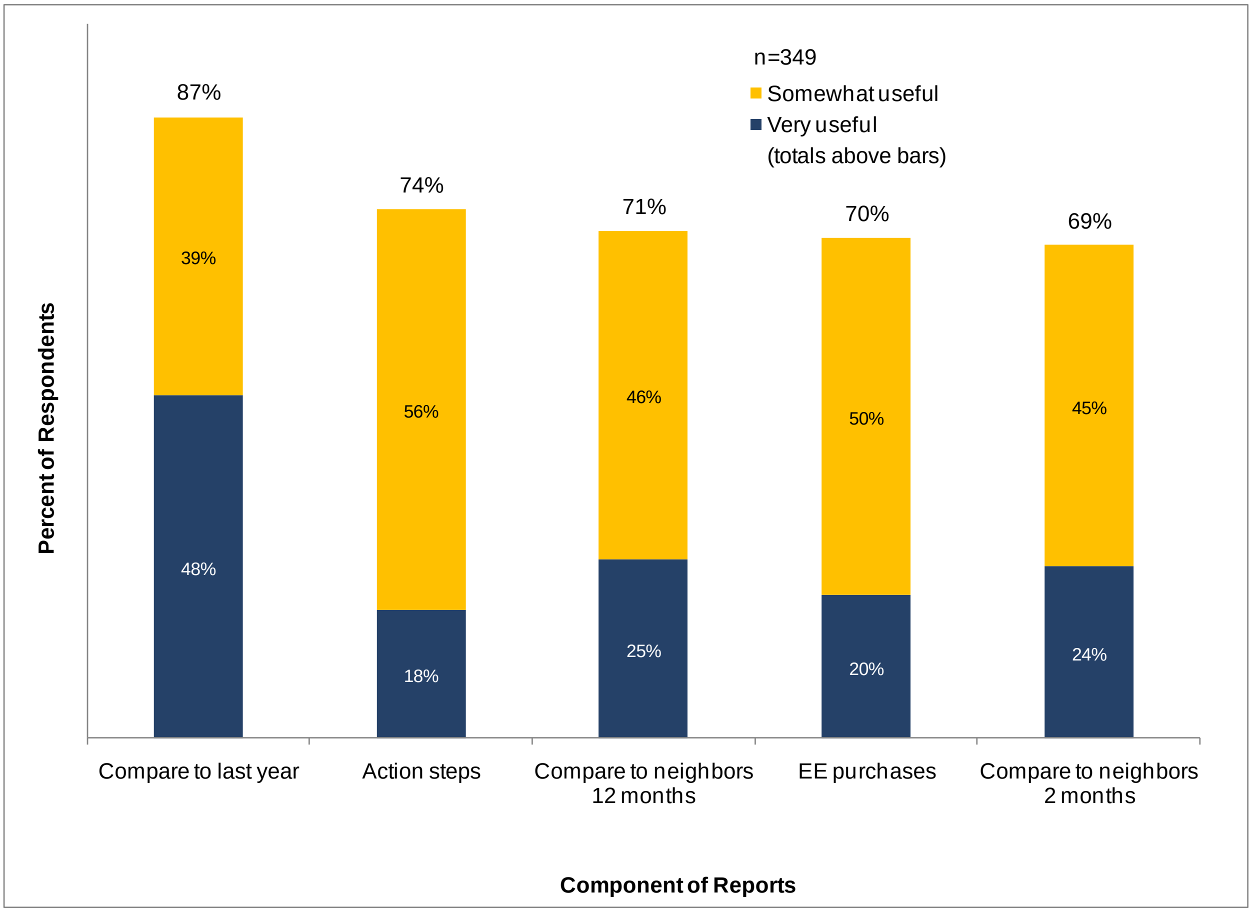
Table 5-11: Usefulness of Reports Categorical Differences

Categories		Usefulness Rating: 1 not at all useful	2	3	4	5 very useful
Age	2 or less (n=176)	9%	13%	35%	24%	20%
	3 or more (n=169)	19%	13%	26%	22%	18%
	sig.	**		*		
Children	No	19%	14%	34%	16%	16%
	Yes	8%	9%	26%	32%	22%
	sig.	**			**	

* Difference statistically significant at 90% confidence level.
** Difference statistically significant at 95% confidence level.

All survey respondents were asked to rate the usefulness of several specific components of the reports. These components consisted of: comparison to own house last year, action steps for reducing energy use, comparison to neighbors' energy use for the last 12 months, comparison to neighbors' energy use for the last two months, and suggestions for energy efficiency (EE) purchases. The usefulness ratings were made on three point scales: very useful, somewhat useful, and not at all useful. Overall, each component was found to be very or somewhat useful by most respondents (Figure 5-8). Comparison to the respondents' own homes was the most useful component.

Figure 5-8: Report Component Usefulness



There were several statistically significant differences in usefulness ratings of the components based on respondent demographics. These included age and presence of children (Table 5-12).

- *Age:* Respondents age 55 or older tended to find the three comparison components less useful than younger respondents. Respondents in the 55 or older age category were more likely than those 35 to 54 category to give a "not at all useful" rating to all three of the comparison components.

- *Children:* Households with children tended to find the comparisons and the purchase tips more useful than those without children. Households with children were more likely than those without children to say the comparisons to neighbors, comparisons to their own household, and the energy efficient purchase recommendations were "very useful".

Note, these two sets of differences are probably opposite sides of the same coin. Respondents over 55 years old are less likely than younger respondents to have children in their household.

Table 5-12: Component Usefulness Categorical Differences

Component Usefulness		Age			Children		
		35 to 54 (n=133)	55+ (n=179)	sig.	No (n=230)	Yes (n=119)	sig.
Last Year	Not at all useful	8%	15%	*	13%	8%	
	Somewhat useful	32%	44%	*	46%	27%	**
	Very useful	61%	40%	**	40%	63%	**
Neighbor (12 month)	Not at all useful	22%	31%	*	30%	20%	*
	Somewhat useful	49%	43%		48%	44%	
	Very useful	29%	24%		21%	34%	**
EE Purchases	Not at all useful	30%	25%		26%	28%	
	Somewhat useful	49%	52%		54%	43%	**
	Very useful	20%	20%		17%	26%	**
Neighbor (2 month)	Not at all useful	23%	34%	**	32%	23%	*
	Somewhat useful	51%	41%	*	45%	45%	
	Very useful	24%	24%		22%	29%	

* Difference statistically significant at 90% confidence level.
** Difference statistically significant at 95% confidence level.

5.4.4 Effects of Reports

Finally, the survey asked whether the reports had caused the respondents to adopt new energy saving habits or purchase more efficient energy using equipment. About one-third (37%) of respondents said the reports caused them to adopt new energy-saving habits and 29 percent said the reports caused them to purchase energy efficient equipment. These results do not completely match the results reported above for the purchases of individual equipment. This discrepancy may be due to the difference in level of abstraction – the previous questions asked about specific types of equipment whereas these questions asked about energy using equipment in general. It is possible the respondents mentally aggregated the earlier responses. It could also be due to the inherent variability in self-reports.

5.4.5 Response to Reports Summary

Respondents are aware of the reports. Most respondents spend a few minutes reading every report their household receives. Respondents are not overwhelmed with the usefulness of the reports. The most useful component of the reports is the comparison of the respondents' continued energy usage to the previous year. About one-third of respondents said the reports caused them to adopt new energy saving habits or install energy efficient equipment.

There were few differences between monthly and quarterly recipients. Monthly report recipients are more likely than quarterly recipients to read every report, but quarterly recipients spend a little more time reading the reports when they do read them.

Respondents with fewer household members read more reports, spend more time when they read them, and find the reports more useful than respondents with more household members. Older respondents appear to be less interested than younger respondents in any of the comparisons provided in the reports. Older respondents also tend to have smaller households, so these findings are a bit mixed.

Respondents with children read fewer reports and spend less time reading them when they do. However, these households do find the comparisons and purchase tips useful.

A. Impact Methodology

A.1 Difference-of-Differences

The difference-of-differences approach is the most direct and simple way of leveraging the experimental design of the HER program. The approach compares the difference in treatment group average consumption between pre- and post-report period with the same difference for the control group. The treatment group pre-post difference captures all changes between the two periods including those related to receiving the reports. The control group captures all changes with the exception of those related to the report, because the control group did not receive the reports. The random selection of the treatment and control groups ensures that, on average, the control group will appropriately reflect the non-report related changes experienced by treatment and control group alike between the pre-and post-report periods. Removing the non-report differences, as represented by the control group difference, from the treatment difference produces an estimate of the report's isolated effect on consumption.

It's extremely important to remember that impacts are unlikely to be evenly distributed across the year, so it is essential that pre- and post-report periods cover the same number of months and the same months of the year. Furthermore, some portion of impact is likely to be weather-correlated. Despite the presence of the control group, difference-of-differences impact estimates reflect the observed weather during the analysis period. This is one of the two primary limitations of the difference of difference approach – it always reflects actual weather.

The average consumption of energy for the treatment group in the pre-report period is calculated with the equation

$$\overline{E}_{Trmt\,\mathrm{Pre}} = \frac{1}{n_{Trmt}} \sum_{i \in Trmt} E_i$$

$\overline{E}_{Trmt\,\mathrm{Pre}}$	=	Average energy consumption in the pre-report period for the treatment group;
n_{Trmt}	=	Count of households in the treatment group;
E_i	=	Energy consumption for household *i*;

Using this equation structure, average energy consumption is calculated for both treatment and control groups in both the pre- and post-report periods. The difference of difference is then produced with the following equation.

$$\Delta E = \left(\overline{E}_{Trmt\ \mathrm{Pre}} - \overline{E}_{TrmtPost}\right) - \left(\overline{E}_{Cont\ \mathrm{Pre}} - \overline{E}_{ContPpost}\right)$$

The difference-of-differences approach can be applied on a monthly or seasonal basis. As long as time periods are balance in the pre- and post-report periods the savings estimate will be consistent for that time period.

A.2 Regression models

For each control and treatment customer, a PRISM-like- heating and cooling model was estimated for each HER period. The generalized site-level model for Stage 1 is:

$$E_{im} = \mu_i + \beta_H H_{im}(\tau_H) + \beta_C C_{im}(\tau_C) + \varepsilon_{im} \qquad \text{Equation 1}$$

where

E_{im}	=	Energy consumption during day *m* for customer *i*;
$H_{im}(\tau_H)$	=	Heating degree-days at the heating base temperature τ_H during day m, based on daily temperature, for customer i's meter reading;
$C_{im}(\tau_c)$	=	Cooling degree-days at the cooling base temperature τ_C during day m, based on daily temperatures, for customer i's meter reading;
μ_i	=	Baseload usage estimate for customer i;
$\beta_{H,}\beta_C$	=	Heating and cooling coefficients, determined by the regression;
τ_H,τ_C	=	Heating and cooling degree-day base temperatures, determined by choice of the optimal regression; and
ε_{im}	=	Regression residual.

Equation 1 shows that daily energy consumption (E_{im}) is a function of an intercept which represents baseload (μ_i), daily HDD, $H_{mi}(\tau_H)$, which correlates with heating usage and daily CDD, $C_{mi}(\tau_C)$, which correlates with cooling usage. If using monthly billing data, monthly bill readings are divided by the number of days in the billing period to get the daily consumption (E_{im}). Average daily degree days for the billing period are calculated by dividing the sum of daily HDD or CDD during the billing period by the number of days in the billing period. It is best to use raw consumption data by bill period rather than calendarized billing data. This maintains full correlation between consumption and degree days over the period.

We estimated consumption across a range of heating and cooling degree day bases instead of fixing degree day base temperatures to 65°F. Heating degree day bases covered 50°F to 70°F while cooling degree day bases covered 64°F to 84°F. Aside from the full model specification[8], we also fit the model with only baseload and heating or cooling term across the same range of base temperatures. Finally, we fit the intercept alone and chose the best heating and cooling degree base combination for each model specification. The F-test was used to determine whether the specification including either heating or cooling or both in the model is superior.

The distributions of cooling and heating base temperatures selected by the model were examined. If either heating or cooling degree day base temperature is on the border, we force the degree day bases to the mean. Instead of considering a range of degree day base temperature, we estimated consumption as a function of cooling and heating using the central base (67 °F for cooling and 61 °F for heating). Similarly, we estimated the following models: heating and cooling, heating-only, and intercept-only. This was done to avoid odd model fit to the data.

Normalized energy consumption

We also estimated consumption on a typical meteorological year. The normalized consumption was estimated using cooling and heating degree days from a typical year, which is provided by TMY3. Weather-normalized daily consumption was computed as follows:

$$NC_{im} = \hat{\mu}_{im} + \hat{\beta}_H \tilde{H}_{im}(\tau_H) + \hat{\beta}_C \tilde{C}_{im}(\tau_C)$$

where

[8] For modeling of gas consumption, heating-only and intercept-only models were used.

NC_{im}	=	Normalized daily consumption for customer *i*;
$\tilde{H}_{im}(\hat{\tau}_H)$	=	Normal heating degree-days calculated at the optimal heating base temperature $\hat{\tau}_H$ of customer i;
$\tilde{C}_{im}(\hat{\tau}_C)$	=	Normal cooling degree-days calculated at the optimal cooling base temperature $\hat{\tau}_C$ of customer i;
$\hat{\mu}_{im}, \hat{\beta}_H, \hat{\beta}_C$	=	Baseload, heating and cooling parameter estimates from the site-level models.

B. Survey Methodology

The KEMA team fielded 1,448 computer-aided telephone interview (CATI) surveys to address the research objectives identified earlier. Prior to designing the CATI instruments, KEMA completed 11 in-depth interviews with program participants. The results of the in-depth interviews informed the design of the CATI instrument.

The in-depth interviews covered the same topics as we planned for the surveys. However, the in-depth interviews were semi-structured and open-ended to allow for a better understanding of how customers think about the issues and the language that they use. It also helped us assess how well participants and non-participants could address the survey questions, and how well they recalled purchases.

To avoid respondent fatigue, KEMA designed the CATI surveys to last 15 minutes. To accomplish a shorter overall survey length while still asking the many questions necessary to cover the research objectives, KEMA grouped the survey into modules. Each module contained a set of questions specific to a content area, so that anyone asked about that content area was asked all the appropriate questions. For example, one module covered appliance purchases – what the participant purchased in the past year and whether or not it was Energy Star. Approximately one half of each study group (control and the two treatment groups) was asked each module.

The KEMA team used the following procedures for survey data collection.

- Sent an advance letter to sampled customers informing them of the study.
- Made at least five attempts for each sampled customer over multiple days and at different times.
- Instituted procedures and scripts for handling answering machines.
- Conducted project specific training of interviewers.
- Provided an FAQ sheet to interviewers to ensure consistent answers to common questions. It included a PSE contact person's name and number for verification.
- Monitored 10 percent of all calls.

During the first week of fielding, it became clear that the survey was taking significantly more than 15 minutes to complete. KEMA made several changes to the instrument to try to reduce the total survey time, but average times still approached 20 minutes. In order to maintain the evaluation budget and timeline, KEMA had to reduce the number of completes from the original target of 1,800 (600 in each condition) to 1,448 (about 500 in each condition).

An additional complication occurred during data analysis. Seventy-nine respondents in the treatment condition were from a group that was chosen to receive the report outside of the regular random assignment procedure for the entire experiment. Because of the absence of random assignment, KEMA had to remove these respondents from the analysis. This reduced KEMA's final number of completed surveys to 1,369.

C. Survey Instrument

Puget Sound Energy
Home Energy Report Savings Double Counting
CATI Survey
(REVISIONS FOR PROGRAMMING 020212)

I INTRODUCTION – ASK ALL – ASK ALL

[READ]: "May I please speak with <Contact Name>?"

[IF CONTACT NAME IS AVAILABLE, READ I1]
[IF CONTACT NAME IS NOT AVAILABLE ARRANGE FOR CALLBACK]

I1 Hello, my name is _________ from the Blackstone Group calling on behalf of Puget Sound Energy. We are conducting a survey about how your household uses energy and purchases energy using equipment.

I'd like to talk about purchases of energy using equipment that you may have made in 2011.

[IF NECESSARY]:

Puget Sound Energy is interested in hearing what you have to say in order to improve the programs they offer to residential customers.

This is NOT a sales call and the information that you provide will be kept strictly confidential. This call may be monitored or recorded for quality purposes, but all of your responses are confidential and will only be reported in the aggregate.

CELL1. First, have you received this call on a wireless phone or on a landline phone?

1	WIRELESS	
2	LANDLINE	
96	REFUSED	**TERMINATE**
97	DON'T KNOW	**TERMINATE**

[IF CELL1=1, ASK CELL2; OTHERWISE GO TO I2]

CELL2. Are you driving a vehicle or using any equipment or machinery that requires your attention?

[INTERVIEWER: IF RESPONDENT SAYS YES, READ] Due to safety reasons we will need to call you back at a more convenient time. Thank you very much.

1 YES **[SET AS SOFT CALLBACK]**
2 NO
96 REFUSED **TERMINATE**
97 DON'T KNOW **TERMINATE**

I2. Do you or anyone else in your household work for a gas or electric utility, including Puget Sound Energy?

1 YES ➔**THANK & TERMINATE**
2 NO
96 REFUSED
97 DON'T KNOW

I3. Do you or anyone else in your household work for a market research company, or conduct market research as part of their job?

1 YES ➔**THANK & TERMINATE**
2 NO
96 REFUSED
97 DON'T KNOW

I4. Are you a person in this house who knows about your household's energy using purchases in 2011?

1 YES
2 NO ➔ [**ASK:** May I speak to that person?] **[SCHEDULE INTERVIEW IF PERSON NOT AVAILABLE OR ARRANGE FOR CALLBACK]**
96 REFUSED ➔**THANK & TERMINATE INTERVIEW**
97 DON'T KNOW ➔**THANK & TERMINATE INTERVIEW**

PS POPULATION SCREENING – ASK ALL

PS1 I am calling about [**READ CUSTOMER ADDRESS**]. Do you live at this address?

1 YES ➔**SKIP TO C1**
2 NO
96 REFUSED
97 DON'T KNOW

PS2 Do you own this address and rent it out to others?

1 YES ➔ **THANK & TERMINATE INTERVIEW**
2 NO ➔ **THANK & TERMINATE INTERVIEW**
96 REFUSED ➔ **THANK & TERMINATE INTERVIEW**
97 DON'T KNOW ➔ **THANK & TERMINATE INTERVIEW**

[THANK & TERMINATE SCRIPT]: Those are all the questions I have for you today. Thank you very much for your time.

C CFL PURCHASE(S) -- ASK ALL

C1 Have you heard of compact fluorescent light bulbs, usually called CFLs?

1 YES ➔ **SKIP TO C3**
2 NO
96 REFUSED
97 DON'T KNOW

C2 Compact fluorescent light bulbs, or CFLs, are small fluorescent bulbs that typically fit in regular light bulb sockets. CFLs are often "twisty" in shape. Have you heard of these? **[READ IF NECESSARY]:** Some of them resemble a soft serve ice-cream cone**.**

1 YES
2 NO ➔**SKIP TO X1**
96 REFUSED ➔**SKIP TO X1**
97 DON'T KNOW ➔**First time = Repeat C2. Second time = SKIP TO X1**

C3 Did you or anyone in your household purchase any CFLs in the past year?

1 YES
2 NO ➔ **SKIP TO X1**
96 REFUSED ➔ **SKIP TO X1**
97 DON'T KNOW ➔ **SKIP TO X1**

C4 Approximately, how many compact fluorescent bulbs did you or someone else in your household purchase in 2011? **[IF NECESSARY]:** Your best estimate is fine**.**

1 ______ # of bulbs
96 REFUSED
97 DON'T KNOW

IF C4=1 BULB SKIP TO C8; ELSE ASK C5

C5 Did you purchase all the CFLs on the same shopping trip?

1 YES ➔ **SKIP TO C8**
2 NO
96 REFUSED
97 DON'T KNOW

C6 REMOVED

C7 On how many different trips did you purchase CFLs in 2011? **[IF NECESSARY SAY –** Your best estimate is fine]

1__________ [RECORD # OF TRIPS]
96 REFUSED ➔ **SKIP TO X1**
97 DON'T KNOW ➔ **SKIP TO X1**

[IF C4_bulb OR C5 = 1 ASK C8-C12 ONCE, ELSE READ INTRO AND LOOP THROUGH C8-C12 THE NUMBER OF TIMES IN C7. MAX LOOPS = 6]

IF C7=2+ READ INTRO: Now I'd like to ask you about each shopping trip on which you purchased CFLs for your household in 2011, starting with the first one.

C8 At what store did you **<IF C7=2+ READ first/next>** buy the CFLs? **[DO NOT READ] [ACCEPT ONLY ONE RESPONSE]**

1 ACE HARDWARE
2 ARIRANG ORIENTAL MARKET
3 BARTELL DRUGS
4 BEST BUY
5 CARNICERIA LA CHIQUITA
6 COSTCO
7 DO IT BEST HARDWARE CENTER

8 DOLLAR PLUS
9 DOLLAR TREE
10 FOSS' GROCERY
11 FRED MEYER
12 FRY'S ELECTRONICS
13 GOODWILL
14 GROCERY OUTLET
15 HADLOCK BUILDING SUPPLY
16 HAGGEN
17 HARDWARE SALES
18 LA TEJANA MEXICAN STORE
19 LAKE SAWYER GROCERY
20 LOWE'S
21 LUMBERMENS
22 MAPLE VALLEY MARKET
23 MCLENDON HARDWARE
24 MERCADITO DEL VALLE
25 OAK HARBOR MARKETPLACE
26 OLYMPIA LIGHTING CENTER
27 ONLY A DOLLAR PLUS
28 PORT ORCHARD MARKETPLACE
29 PUGET PANTRY
30 RITE AID
31 SEBO'S DO IT CENTER
32 THE MARKETS
33 THE STAR STORE, INC.
34 TRUE VALUE HARDWARE
35 VALLEY HARVEST MARKET / VALLEY HARVEST II INTERNATIONAL MARKET
36 VILLAGE LIGHTING
37 WALGREENS
38 WALMART
39 WALT'S LYNWOOD CENTER MARKET
40 WESTSIDE BUILDING SUPPLY DO IT CENTER
41 WINCO
42 HOME DEPOT
95 OTHER (SPECIFY) ____________________
96 REFUSED
97 DON'T KNOW

C9 In what city or town is this store located? **[DO NOT READ] [ACCEPT ONLY ONE RESPONSE]**

1 ANACORTES
2 AUBURN
3 BAINBRIDGE ISLAND
4 BELLEVUE
5 BELLINGHAM
6 BLACK DIAMOND
7 BLAINE
8 BONNEY LAKE
9 BOTHELL
10 BREMERTON
11 BURIEN
12 BURLINGTON
13 CLINTON
14 COVINGTON
15 DES MOINES
16 EDGEWOOD
17 ELLENSBURG
18 ENUMCLAW
19 EVERSON
20 FEDERAL WAY
21 FERNDALE
22 FREELAND
23 GRAHAM
24 ISSAQUAH
25 KENMORE
26 KENT
27 KINGSTON
28 KIRKLAND
29 LACEY
30 LANGLEY
31 LYNDEN
32 MAPLE VALLEY
33 MERCER ISLAND
34 MOUNT VERNON
35 NEWCASTLE
36 NORTH BEND
37 OAK HARBOR
38 OLYMPIA
39 PORT HADLOCK

40 PORT ORCHARD
41 PORT TOWNSEND
42 POULSBO
43 PUYALLUP
44 REDMOND
45 RENTON
46 SAMMAMISH
47 SEDRO WOOLLEY
48 SILVERDALE
49 SUMNER
50 TUKWILA
51 TUMWATER
52 WOODINVILLE
53 YELM
95 OTHER (SPECIFY) _______________
96 REFUSED
97 DON'T KNOW

C10 In approximately what month did you make this purchase? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
13 WINTER
14 SPRING
15 SUMMER
16 FALL
17 FIRST HALF OF THE YEAR
18 SECOND HALF OF THE YEAR
96 REFUSED

97 DON'T KNOW

AUTO FILL WITH RESPONSE FROM C4_NUM IF C5=1 [ONE TRIP] AND SKIP TO C12

C11 And how many bulbs did you purchase in <month in C10>? **[IF NECESSARY]:** Your best estimate is fine.

1__________ # of bulbs
96 REFUSED ➔ **SKIP TO C13**
97 DON'T KNOW ➔ **SKIP TO C13**

C12 How many of these bulbs are currently installed in or around your home?

1__________ [RECORD #]
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE: CAP C12 SO THAT IT DOES NOT EXCEED C11]

SKIP C13 IF C12=0 BULBS; ELSE ASK C14

C13 You indicated that you purchased [INSERT RESPONSE FROM C4, IF DK OR REF INSERT 'some'] CFL bulbs in 2011. What type of bulb did **[IF C12_NUM >1: *the majority* of these CFLs /IF C12_NUM=1, DK, REF: *the CFL*>** replace . . .? **[READ 1-94] [DO NOT ACCEPT MULTIPLE REPLIES].**

1 Other CFLs,
2 Regular/incandescent bulbs,
3 Halogen bulbs,
4 A mix of CFL and other bulbs, or
94 They did not replace other bulbs?
95 SOMETHING ELSE
96 REFUSED
97 DON'T KNOW

ASK ALL

C14 I'd like to know what you did with the bulbs you did **not** install. Did you . . .? **[READ LIST]**

1 store them in your home,
2 give them away,

3 return them to the store, or
95 do something else with them? (SPECIFY: ____________)
94 I INSTALLED THEM ALL
96 REFUSED
97 DON'T KNOW

ASK ONCE FOR ALL BULBS

C15 What, if anything, influenced your household to purchase the CFLs? Anything else? **[DO NOT READ] [ACCEPT MULTIPLE REPLIES]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. ANY REBATE
4 LETTER OR BILL INSERT FROM PSE
5 PSE WEBSITE, PSE ADVERTISING
6 SALESPERSON
7 MANUFACTURER ADVERTISING, NEWS, OR OTHER MEDIA
8 HOME ENERGY REPORT
9 LAST LONGER
10 PRICE OF BULB (ON SALE/WAS FREE)
11 ONLY TYPE AVAILABLE/PHASING OUT OF INCANDESCENT LIGHT BULBS
12 LIGHT QUALITY
13 WANTED TO TRY THEM/TRY SOMETHING NEW/SEE HOW THEY WORK
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

X Compact Fluorescent Fixtures -- ASK ALL

X1 Have you ever heard of compact fluorescent fixtures?

1 YES **➔ SKIP TO X3**
2 NO
96 REFUSED
97 DON'T KNOW

X2 Compact fluorescent fixtures use pin-based CFLs that plug into the fixture. You don't screw them in. These fixtures often have an Energy Star label. Have you heard of these?

1 YES
2 NO **➔SKIP TO HC1**
96 REFUSED **➔SKIP TO HC1**
97 DON'T KNOW **➔First time = Repeat X2. Second time = SKIP TO HC1**

X3 Did you or someone in your household buy any CFL *fixtures* in 2011?

1 YES
2 NO ➔ **SKIP TO HC1**
96 REFUSED ➔ **SKIP TO HC1**
97 DON'T KNOW ➔ **SKIP TO HC1**

X4 How many CFL *fixtures* did you buy in 2011?

1 ONE ➔**SKIP TO X8**
2 TWO
3- THREE OR MORE
96 REFUSED
97 DON'T KNOW

X5 Did you purchase all the CFL fixtures on the same shopping trip?

1 YES ➔ **SKIP TO X8**
2 NO
96 REFUSED ➔ **SKIP TO X8**
97 DON'T KNOW ➔ **SKIP TO X8**

X6 REMOVED

X7 On how many different trips did you purchase CFL fixtures in 2011?

1__________ [RECORD # OF TRIPS]
96 REFUSED ➔ **SKIP TO HC1**
97 DON'T KNOW ➔ **SKIP TO HC1**

[IF X5=YES ASK X8-X14 ONCE. IF X7=2+ READ INTRO AND LOOP THROUGH X8-X14 FOR EACH TRIP. MAX LOOPS=6]: INTRO: Now I'd like to ask you about each shopping trip when you purchased a CFL fixture, starting with the first one.

X8 At what store did you **<IF X7=2+ READ first/ next>** purchase a CFL fixture in 2011? **[DO NOT READ. ACCEPT ONLY ONE RESPONSE]**

1 ACE HARDWARE
2 ARIRANG ORIENTAL MARKET
3 BARTELL DRUGS
4 BEST BUY
5 CARNICERIA LA CHIQUITA
6 COSTCO
7 DO IT BEST HARDWARE CENTER

8 DOLLAR PLUS
9 DOLLAR TREE
10 FOSS' GROCERY
11 FRED MEYER
12 FRY'S ELECTRONICS
13 GOODWILL
14 GROCERY OUTLET
15 HADLOCK BUILDING SUPPLY
16 HAGGEN
17 HARDWARE SALES
18 LA TEJANA MEXICAN STORE
19 LAKE SAWYER GROCERY
20 LOWE'S
21 LUMBERMENS
22 MAPLE VALLEY MARKET
23 MCLENDON HARDWARE
24 MERCADITO DEL VALLE
25 OAK HARBOR MARKETPLACE
26 OLYMPIA LIGHTING CENTER
27 ONLY A DOLLAR PLUS
28 PORT ORCHARD MARKETPLACE
29 PUGET PANTRY
30 RITE AID
31 SEBO'S DO IT CENTER
32 THE MARKETS
33 THE STAR STORE, INC.
34 TRUE VALUE HARDWARE
35 VALLEY HARVEST MARKET / VALLEY HARVEST II INTERNATIONAL MARKET
36 VILLAGE LIGHTING
37 WALGREENS
38 WALMART
39 WALT'S LYNWOOD CENTER MARKET
40 WESTSIDE BUILDING SUPPLY DO IT CENTER
41 WINCO
42 HOME DEPOT
95 OTHER (SPECIFY) ____________________
96 REFUSED
97 DON'T KNOW

X9 In what city or town is this store located? **[DO NOT READ. ACCEPT ONLY ONE RESPONSE]**

1 ANACORTES
2 AUBURN
3 BAINBRIDGE ISLAND
4 BELLEVUE
5 BELLINGHAM
6 BLACK DIAMOND
7 BLAINE
8 BONNEY LAKE
9 BOTHELL
10 BREMERTON
11 BURIEN
12 BURLINGTON
13 CLINTON
14 COVINGTON
15 DES MOINES
16 EDGEWOOD
17 ELLENSBURG
18 ENUMCLAW
19 EVERSON
20 FEDERAL WAY
21 FERNDALE
22 FREELAND
23 GRAHAM
24 ISSAQUAH
25 KENMORE
26 KENT
27 KINGSTON
28 KIRKLAND
29 LACEY
30 LANGLEY
31 LYNDEN
32 MAPLE VALLEY
33 MERCER ISLAND
34 MOUNT VERNON
35 NEWCASTLE
36 NORTH BEND
37 OAK HARBOR
38 OLYMPIA
39 PORT HADLOCK
40 PORT ORCHARD

41 PORT TOWNSEND
42 POULSBO
43 PUYALLUP
44 REDMOND
45 RENTON
46 SAMMAMISH
47 SEDRO WOOLLEY
48 SILVERDALE
49 SUMNER
50 TUKWILA
51 TUMWATER
52 WOODINVILLE
53 YELM
95 OTHER (SPECIFY) _______________
96 REFUSED
97 DON'T KNOW

X10 In approximately what month did you make this purchase? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

[ASK IF (X4=2 & X5≠1), OR X4=3] AUTO-FILL A "1" IF X4=1 AND AUTOFILL A "2" IF X4=2 AND X5=1

X11 How many CFL fixtures did you purchase at that time?

1__________ [RECORD #]

96 REFUSED➔ **SKIP TO X13**
97 DON'T KNOW➔ **SKIP TO X13**

X12 **<IF X11=1 Is this CFL fixture/IF x11=2+ Are all of these CFL fixtures>** currently installed in your home?

1 YES ➔ **SKIP TO X13**
2 NO
96 REFUSED ➔ **SKIP TO X13**
97 DON'T KNOW ➔ **SKIP TO X13**

IF X11=1 FIXTURE AND X12=NO, SKIP TO X14

X12a How many of the fixtures purchased on this shopping trip are currently installed in your home?

1 __________ [RECORD #]
96 REFUSED
97 DON'T KNOW

PROGRAMMER: FOR X13 TEXT INSERTION, AUTO-FILL X12a=X11 IF X12=YES

IF X12a=0 FIXTURES, SKIP TO X14

X13 What did the new CFL **<IF X12a=1: fixture/IF X12a=2+fixtures>** replace? **<IF X12a=1:** Was it/ **IF X12a=2+**Were they> . . . **[READ LIST]**

1 Regular/incandescent fixture with regular bulbs,
2 Regular fixture with CFLs,
3 A halogen fixture,
4 A CFL fixture,
94 It was an additional fixture, or
95 Something else? (SPECIFY_______________)
96 REFUSED
97 DON'T KNOW

[IF X11 >X12a (NUMBER PURCHASED > NUMBER INSTALLED ASK X14, ELSE SKIP TO X15]

X14 I'd like to know what you did with the fixture(s) you did not install. Did you ? **[READ LIST]**

1 Store it/them in your home,
2 Give it/them away,

3 Return it/them to the store, or
95 Do something else? (SPECIFY ____________)
96 REFUSED
97 DON'T KNOW

[ASK ONE TIME FOR ALL FIXTURES]

X15 What influenced your household to purchase a CFL fixture? **[DO NOT READ. ACCEPT MULTIPLE RESPONSES]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

HC Heating and Cooling System – ASK ONLY IF BEHAVIOR SEQUENCE = 1, 2, 4, 5 or 6

[READ]: Now, I'd like to ask you a few questions about purchases related to your home heating and cooling.

HC1. In 2011, did your household purchase and install any of the following? … **[READ]**

a A furnace
b A boiler
c a central air conditioner
d a room air conditioner
e an air source heat pump
f a geothermal heat pump
g ductless heat pump

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE: WANT THIS VARIABLE TO BE CREATED]

HCTYPE	= "Furnace"	if HC1a= 1
	= "boiler"	if HC1b = 1
	= "central air conditioner"	if HC1c = 1
	= "room AC"	if HC1d = 1
	= "air source heat pump"	if HC1e = 1
	= "geothermal heat pump	if HC1f = 1
	= "ductless heat pump	if HC1g = 1

IF BEHAVIOR SEQUENCE = 2 OR 5, SKIP TO INSTRUCTIONS BEFORE HC10

HEATING Section only

[ASK IF HC1a, HC1b, HC1e OR HC1f=1]
First, I'm going to ask you specific questions about your <HCTYPE>

ASK HC2-HC9 AND HC18 IF BEHAVIOR SEQUENCE = 1, 4 OR 6; ELSE SKIP TO INSTRUCTIONS BEFORE HC10

HC2 In approximately what month did you install the <HCTYPE>? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

[ASK IF HC1a=1 OR HC1b= 1], FURNACE OR BOILER
HC3 What fuel does your new <HCTYPE> use? **[SELECT ONE RESPONSE] [READ]**

1 Natural gas,
2 Electricity, ➔ **SKIP TO HC7**
3 Propane or
95 something else? (SPECIFY:____________)
96 REFUSED
97 DON'T KNOW ➔

HC4 Did you get a rebate from Puget Sound Energy for the <HCTYPE>?

1 YES ➔ **SKIP TO HC7**
2 NO
96 REFUSED
97 DON'T KNOW

HC4a Will you apply for a 2011 Federal Tax Credit for this <HCTYPE>?

1 YES ➔ **SKIP TO HC7**
2 NO
96 REFUSED
97 DON'T KNOW

HC5 Does your <HCTYPE> have an ENERGY STAR label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 Yes ➔ **SKIP TO HC7**
2 No
96 REFUSED
97 DON'T KNOW

[ASK ONLY IF HC1a=1 or HC1b = 1, AND HC3=1 AND HC4 ≠ 1 AND HC4a ≠ 1 AND HC5 ≠ 1], IF IT IS A NATURAL GAS FURNACE OR BOILER, AND THEY SAY THAT IT DID NOT HAVE AN ENERGY STAR LABEL
HC6 Does your new <HCTYPE> have an exhaust vent that… **[READ]**

1 Goes up through the roof, or
2 Is plastic and goes out the side of the house?
96 REFUSED
97 DON'T KNOW

HC7 Approximately how old was the heating system that it replaced **[USE BRACKETING IF SAY DON'T KNOW]**

1 _______________ approximate age in years
96 REFUSED
97 DON'T KNOW

HC8 What fuel did your *old* heating system use? Was it . . . **[READ] [ACCEPT ONLY ONE RESPONSE]**

1 Natural gas,
2 Electricity,
3 Propane or
95 something else? (SPECIFY:____________)
96 REFUSED
97 DON'T KNOW

[ASK IF HC8 = 1]
HC9 Did the old heating system have an exhaust vent that…**[READ]**

1 Went up through the roof, or
2 Was plastic and went out the side of the house?
96 REFUSED
97 DON'T KNOW

CENTRAL AC AND DUCTLESS HEAT PUMP QUESTIONS
[ASK IF (HC1c=1 OR HC1g= 1) AND BEHAVIOR SEQUENCE = 1, 2 OR 5]

HC10 In approximately what month did you install the <HCTYPE>? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER

96 REFUSED
97 DON'T KNOW

[ASK IF HC1c = 1 AND BEHAVIOR SEQUENCE = 1, 2 OR 5]
HC10a Will you apply for a 2011 Federal Tax Credit for this <HCTYPE>?
1 YES ➔ **SKIP TO HC12**
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF (HC1c =1 OR HC1g= 1) AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT CENTRAL AIR CONDITIONER OR DUCTLESS HEAT PUMP
HC11 Does your new <HCTYPE> have an ENERGY STAR label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]
1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF (HC1c =1 OR HC1g= 1) AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT CENTRAL AIR CONDITIONER OR DUCTLESS HEAT PUMP

HC12 Did your new <HCTYPE> replace… **[READ]**
1 A central air conditioner,
2 an air source heat pump,
3 a geothermal heat pump,
4 one or more room air conditioners. or ➔ **SKIP TO HC14**
5 is this additional cooling? ➔ **SKIP TO HC14**
96 REFUSED
97 DON'T KNOW

[ASK IF (HC1c =1 OR HC1g= 1) AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT CENTRAL AIR CONDITIONER OR DUCTLESS HEAT PUMP

HC13 Approximately how old was the unit it replaced?
1 ______________ APPROXIMATE AGE IN YEARS
96 REFUSED
97 DON'T KNOW

END of CENTRAL AC AND DUCTLESS HEAT PUMP QUESTIONS

ROOM AC QUESTIONS
[ASK IF HC1d= 1 AND BEHAVIOR SEQUENCE = 1, 2 OR 5]

[ASK IF HC1d=1] BOUGHT ROOM AIR CONDITIONER
HC14 How many new room ACs did you install in 2011?

1 ______________ #
96 REFUSED
97 DON'T KNOW

[ASK IF HC1d=1 AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT ROOM AIR CONDITIONER
HC15 Did the new room air conditioner(s) replace . . .?

1 another room air conditioner,
2 a ductless heat pump,
3 or is it additional cooling?
96 REFUSED
97 DON'T KNOW

[ASK IF HC1d=1 AND BEHAVIOR SEQUENCE = 1, 2 OR 5] BOUGHT ROOM AIR CONDITIONER
HC16 Did the new room air conditioner(s) have an Energy Star label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF HC15=1 OR HC15=2] REPLACED CONDITIONING UNIT
HC17 Approximately how old was/were the unit(s) replaced?

1 ______________ APPROXIMATE AGE OF ROOM AC
96 REFUSED
97 DON'T KNOW

END OF ROOM AC QUESTIONS

ASK HC18 IF BEHAVIOR SEQUENCE = 1, 2, 4, 5 OR 6

[ASK if HC4 = 1 or HC4a =1 or HC5 =1 or HC6 =2 or HC10a=1 or HC11 = 1 or HC16 = 1]
HC18 What, if anything, influenced your decision to purchase an ***energy efficient*** heating or cooling system? [DO NOT READ] [ACCEPT MULTIPLE REPLIES]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

W Water Heater – ASK ONLY IF BEHAVIOR SEQUENCE = 3, 4 OR 5

W1. Did your household install a new water heater in 2011?

1 YES
2 NO ➔ **SKIP TO IS1**
96 REFUSED ➔ **SKIP TO IS1**
97 DON'T KNOW ➔ **SKIP TO IS1**

W2 In what month did you install your new water heater? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY

2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

W3 Is your new water heater a . . . ? **[READ] [SELECT ONE ANSWER]**
1 Storage tank water heater,
2 whole house tankless or on-demand water heater,
3 heat pump water heater, ➔ **SKIP TO W5**
4 Solar water heater, or ➔ **SKIP TO W6**
95 some other type of water heater? (SPECIFY _______) ➔ **SKIP TO W6**
96 REFUSED ➔ **SKIP TO W8**
97 DON'T KNOW ➔ **SKIP TO W8**

[ASK IF W3 = 1 OR W3 = 2] STORAGE TANK OR, TANKLESS
W4 What is the primary fuel used by your new water heater? Is it. . . **[READ] [DO NOT ACCEPT MULTIPLE REPLIES]**
1 Natural gas.
2 Electricity,
3 Propane, or
95 Something else (SPECIFY:____________)
96 REFUSED
97 DON'T KNOW

[ASK IF W3=1, 2, 3] STORAGE TANK, WHOLE HOME TANKLESS OR HEAT PUMP WATER HEATER
W5 Did you get a rebate from Puget Sound Energy for your new water heater?
1 YES ➔ **SKIP TO W8**
2 NO
96 REFUSED

97 DON'T KNOW

[ASK IF (W3=1, 2, 3, AND W5 ≠1), OR W3 = 4, 95] NO PSE REBATE FOR TANK OR HEAT PUMP, OR TYPE NOT ELIGIBLE FOR PSE REBATE

W6 Did your <TYPE> have an ENERGY STAR label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 YES **➔ SKIP TO W8**
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF W3 = 3 AND W5≠1 AND W6≠1] FEDERAL TAX CREDITS AVAILABLE ONLY FOR HEAT PUMP WATER HEATERS.

W6a Will you apply for a 2011 Federal Tax Credit for this water heater?

1 YES **➔ SKIP TO W8**
2 NO **➔ SKIP TO W8**
96 REFUSED **➔ SKIP TO W8**
97 DON'T KNOW **➔ SKIP TO W8**

[ASK IF W4 = 1 AND W6 = 2] (NATURAL GAS AND NO TO ENERGY STAR)

W7 Does your new <TYPE> have a . . .

1 flue that goes up through the roof, or
2 a plastic pipe that goes out the side of the house?
96 REFUSED
97 DON'T KNOW

W8 Did your new water heater replace a . . .? **[READ]**

1 Storage tank,
2 heat pump
3 tankless /on demand
4 Solar, or
95 Something else (SPECIFY)_______
94 NOTHING / DID NOT REPLACE ANYTHING **➔SKIP W11**
96 REFUSED
97 DON'T KNOW

W9 Approximately how old was the water heater that you replaced **[USE BRACKETING IF SAY DON'T KNOW] [INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES BEFORE ACCEPTING A DON'T KNOW RESPONSE]**

1 ______________ APPROXIMATE AGE IN YEARS
96 REFUSED
97 DON'T KNOW

W10 What fuel did your old water heater use? **[READ. DO NOT ACCEPT MULTIPLE REPLIES]**

1 Natural gas,
2 Electricity,
3. Propane, or
95 Something else
96 REFUSED
97 DON'T KNOW

[ASK IF W5=1 OR IF W6=1 OR W6a= 1 OR W7 = 2] ASK IF THEY GOT A PSE REBATE AN ENERGY STAR RATED WATER HEATER OR THE FLUE IS A PLASTIC PIPE THAT GOES OUT THE SIDE]

W11 What, if anything, influenced your decision to purchase an ***energy efficient*** water heater [DO NOT READ] [ACCEPT MULTIPLE REPLIES]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

IS Insulation – ASK ONLY IF BEHAVIOR SEQUENCE = 2 , 3 OR 6

IS1 In 2011, did your household add any new insulation to the…How about the . . . **[READ EACH]**

a Attic
b Walls
c Floors
d Ducts in unheated spaces

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE: WANT THIS VARIABLE TO BE CREATED]
ISTYPE =

"attic insulation"	if IS1a = 1
"wall insulation"	if IS1b = 1
'floor insulation"	if IS1c = 1
"insulation to ducts in unheated spaces"	if IS1d = 1

[ASK FOR EACH IS1a-ISd = 1] [IF NONE INSTALLED – SKIP TO IS4]

IS2 In what month did you install [ISTYPE]? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

IS3 Did you get a rebate from PSE for the [ISTYPE]?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

IS4 In 2011, did your household add any caulking or weather-stripping?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK ONE TIME FOR ALL INSULATION AND CAULKING WEATHERSTRIPPING.]
[ASK IF ANY IS1a-IS1d = 1 OR IS4 = 1]
IS5 What, if anything, influenced your decision to install the insulation, caulk or weatherstripping?
[DO NOT READ] [ACCEPT MULTIPLE REPLIES]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

A Appliances – ASK ONLY IF BEHAVIOR SEQUENCE = 2, 3 OR 6

[READ]: Now, I'd like to ask you a few questions related to any appliances you may have purchased in the past year.

A1 In 2011, did your household purchase a . . .? **[READ LIST]**

a Refrigerator
b Freezer
c Clothes washer
d Clothes Dryer
e Dishwasher
f Dehumidifier

1 Yes
2 No
96 REFUSED
97 DON'T KNOW

[IF NONE PURCHASED, SKIP TO EE1]

[PROGRAMMER NOTE: WANT THIS VARIABLE TO BE CREATED]
ATYPE =

" refrigerator"	A1a=1
"freezer "	A1b=1
"clothes washer"	A1c=1
"clothes dryer "	A1d=1
"dishwasher "	A1e=1
"dehumidifier"	A1f=1

[ASK IF A1a=1, REFRIGERATOR]
A2 Did you get a rebate from PSE for the new refrigerator?
1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IFA1c = 1, CLOTHES WASHER]
A3 Did you get a WashWise rebate for the new clothes washer?
1 YES
2 NO
96 REFUSED
97 DON'T KNOW

LOOP A4-A6 FOR EACH APPLIANCE PURCHASED
A4 In what month did you purchase your new <appliance>? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

[ASK A5 IF A2≠1 AND A3 ≠ 1, ELSE SKIP TO A6]
(DID NOT GET A PSE REBATE, DID NOT GET A WASHWISE REBATE, OR WAS NOT A REFRIGERATOR OR CLOTHES WASHER)

A5 Does your new <ATYPE> have an ENERGY STAR label? [**INTERVIEWER NOTE: YOU CAN ENCOURAGE CLIENTS TO SEE IF THEIR APPLIANCE HAS AN ENERGY STAR LABEL] [READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 YES
2 NO
96 REFUSED **➔ SKIP TO EE1**
97 DON'T KNOW

A6 Did your new <ATYPE> replace an existing <ATYPE>?

1 YES
2 NO
96 REFUSED **➔ SKIP TO EE1**
97 DON'T KNOW

[ASK IF A2=1, A3=1 OR A5=1]

A7 What, if anything, influenced your decision to buy an ***energy efficient*** appliance? **[DO NOT READ] [CHECK ALL THAT APPLY]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

EE Electronic Equipment – ASK ONLY IF BEHAVIOR SEQUENCE = 3, 4 OR 5

[READ]: Now, I'd like to ask you a few questions related to electronic equipment you may have purchased in the past year.

EE1 In 2011, did your household buy a . . .? **[READ LIST]**
a TV
b Computer **[INCLUDES LAPTOPS]**
c Computer monitor
d Digital video recorder **(DVR, like TeVO)**

1 Yes
2 No
96 REFUSED
97 DON'T KNOW

[REPEAT FOR EACH EE1a-d = 1]
[PROGRAMMER NOTE: WANT THIS VARIABLE TO BE CREATED]

ETYPE = "TV"	if EE1a = 1
= "Computer"	if EE1b = 1
= "Computer monitor"	if EE1c = 1
= DVR"	if EE1d = 1

[SKIP TO B1 IF EE1a-EE1d≠1]
EE2 How many [ETYPEs] did you buy?
1 ___________# [ETYPE] PURCHASED

96 REFUSED
97 DON'T KNOW

[IF EE2>1, READ]: "Now I'd like to ask about each [ETYPE] you bought separately"

[REPEAT EE3-EE4 FOR EACH EE2=1]
EE3 Does your **<IF EE2>1, USE first/next>** new [ETYPE] have an ENERGY STAR label? **[READ IF NECESSARY:** The energy star label shows the word energy, written in script, with a star symbol at the end of the word]

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

EE4 Did your new [ETYPE] replace an existing [ETYPE] or was it additional equipment?

1 REPLACED
2 ADDITIONAL EQUIPMENT
96 REFUSED
97 DON'T KNOW

[ASK IF EE3=1 FOR ANY EETYPE; ONLY ASK ONCE]
EE5 What, if anything, influenced your decision to buy ***Energy Star*** equipment? **[DO NOT READ. ACCEPT MULTIPLE RESPONSES]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BG Behavior – ASK ALL

BG1 Do you discuss with other members of your household how your household uses energy?

1 YES
2 NO ➔ **SKIP TO BHH1**
96 REFUSED ➔ **SKIP TO BHH1**
97 DON'T KNOW ➔ **SKIP TO BHH1**

BG2 What types of things do you discuss? (anything else) **[DO NOT READ] [CHECK ALL THAT APPLY]**

1 SAVING MONEY
2 SAVING ENERGY
3 TURNING THINGS OFF (LIGHTS, COMPUTERS, OTHER)
4 ENVIRONMENT, GLOBAL WARMING, CLIMATE CHANGE
5 HOW MUCH ENERGY DIFFERENT APPLIANCES USE
6 CLOSING DOORS/WINDOWS/SHADES
7 HOME ENERGY REPORT AND OTHER ENERGY USE COMPARISONS
8 SAVING WATER/HOT WATER USAGE
9 THERMOSTAT SETTINGS/TURNING DOWN THE HEAT
10 LIGHT BULBS
11 CLOSE FRIDGE DOOR
12 BUILDING SHELL IMPROVEMENTS
95 OTHER (SPECIFY ____________)
96 REFUSED
97 DON'T KNOW

BHH Behavior-Home Heating – ASK IF BEHAVIOR SEQUENCE = 1, 4 OR 6

[READ]: I'd like to know if there are any things that you have done in the past year to keep your heating costs down. These are things that some people do, but that some do not. There are no right or wrong answers.

BHH1 In the past year, did you regularly turn down the heat at night?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

BHH2 In the past year, did you regularly turn down the heat during the day when no one was home?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

BHH4 In the past year, did you regularly run ceiling fans in reverse during the winter?

1 YES
2 NO
3 NOT RECOMMENDED [IF VOLUNTEERED]
99 NOT APPLICABLE – DOES NOT OWN CEILING FAN
96 REFUSED
97 DON'T KNOW

BHH5 In the past year, did you regularly turn down the thermostat when using your fireplace?

1 YES
2 NO
3 NOT RECOMMENDED [IF VOLUNTEERED]
99 NOT APPLICABLE – DOES NOT OWN FIREPLACE
96 REFUSED
97 DON'T KNOW

BHH6 In the past year, did you clean or replace air filters for you heating system, as recommended?

1 YES
2 NO
3 NOT RECOMMENDED [IF VOLUNTEERED]
99 NOT APPLICABLE – NO AIR FILTERS
96 REFUSED
97 DON'T KNOW

BHH7 Now, I'm going to read a list of additional actions you may have taken. In the past year, did you… **[READ] [CHECK ALL THAT APPLY]**

a. seal leaky ducts?
b. install storm windows?
c. **[SKIP IF BHH5=99]** improve your fireplace sealing?
d. Have a professional do a service check on your heating system?
e. **[SKIP IF BHH5=99]** Install a fireplace insert?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE: BHH8-11 WERE REMOVED]

[ASK IF ANY YES TO ANY BHH ITEMS]

BHH12 What, if anything, influenced you to take any of these actions we just discussed? **[DO NOT READ] [CHECK ALL THAT APPLY]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
9 EQUIPMENT MAINTENANCE/REGULAR CLEANING
10 FIX BROKEN EQUIPMENT
11 HABIT/COMMON SENSE
12 HEALTH AND SAFETY
13 MAKE HOME MORE COMFORTABLE
14 RECOMMENDED BY MANUFACTURER
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BAC Behavior-Air Conditioning – ASK IF BEHAVIOR SEQUENCE = 1, 2 OR 5

[READ]: I'd like to know if there are any things that you have done to keep your cooling costs down. These are things that some people do, but that some do not. There are no right or wrong answers.

BAC1 In the past year did you…**[READ]**

a **[SKIP IF BHH4=99]** regularly use a ceiling fan for home cooling?
b **[SKIP IF BHH4=99]** install a ceiling fan for home cooling?
c regularly close your shades in the summer?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[PROGRAMMER NOTE BA2-BA3 NO LONGER IN SURVEY]

BAC4 Did your household own and use at least one air conditioner in the past year?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF BAC4=1]
BAC5 In the past year did you…[**READ]**
a regularly turn off the air conditioner when no one was at home?
b regularly keep the doors and windows closed when the air conditioner was on?
c seal the area around window air conditioners?
d clean the area around your air conditioner?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE – NO ROOM AC

[ASK IF ANY OF THE FOLLOWING WERE YES (=1), BAC1a-BAC1c, BAC5a–BAC5d]
BAC6 What, if anything, influenced you to take any of these actions we just discussed? (anything else)?
[DO NOT READ]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE ‘GREEN’ OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
9 HABIT/COMMON SENSE
10 EQUIPMENT MAINTENANCE
11 KEEP THE HOUSE COOL
12 KEEP SUN OUT
13 MAKE HOME MORE COMFORTABLE
14 COOLING NOT REQUIRED IN WASHINGTON STATE
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON’T KNOW

BL Behavior-Lighting – ASK IF BEHAVIOR SEQUENCE = 3, 4 OR 5

[READ]: Now I’d like to talk about steps you may have taken to reduce your home lighting use. Some people do these things, some do not.

BL1 In the past year did you . . . **[READ]**
a Regularly turn off lights when not needed?
b Install outdoor motion detectors instead of keeping lights on at night?
c Replace electric outdoor lighting with solar lights?
d Install any LED lights in or around your home?

1 YES
2 NO
96 REFUSED
97 DON’T KNOW

[ASK IF ANY OF THE ANSWERS FOR BL1a-d=1]

BL2 What, if anything, influenced you to take any of these actions we just discussed? (anything else) **[DO NOT READ]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BHW Behavior-Hot Water – ASK IF BEHAVIOR SEQUENCE = 3, 4 OR 5

[READ]: Now I'd like to talk about steps you may have taken to reduce your water heating costs. Some people do these things, some do not.

BHW1 In the past year, did you…**[READ]**

a regularly turn down the water heater temperature to a very low setting when you were away for two or more days?
b Lower your water heater temperature and keep it at the lower setting?
c Insulate your hot water pipes?
d Install showerheads that had a lower flow than what they replaced?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF ANY BHW1a-d=1]

BHW2 What, if anything, influenced you to take any of these actions we just discussed? **[DO NOT READ] [CHECK ALL THAT APPLY]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BA Behavior-Appliances – ASK IF BEHAVIOR SEQUENCE = 2 ,3 OR 6

[READ]: Now I'd like to talk about steps you may have taken to reduce your appliance use. Some people do these things, some do not.

BA1 In the past year, did you reduce the number of working refrigerators in your house?
1 YES
2 NO ➔ **SKIP TO BA4**
96 REFUSED ➔ **SKIP TO BA4**
97 DON'T KNOW ➔ **SKIP TO BA4**

BA2 Did you get cash back from PSE for discarding the refrigerator?
1 YES
2 NO
96 REFUSED ➔ **SKIP TO BA4**
97 DON'T KNOW

BA3 In what month did you discard the refrigerator? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL

5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER
96 REFUSED
97 DON'T KNOW

BA4 In the past year, did you reduce the number of standalone freezers in your house?

1 YES
2 NO ➔ **SKIP TO BA7**
96 REFUSED ➔ **SKIP TO BA7**
97 DON'T KNOW ➔ **SKIP TO BA7**

BA5 Did you get cash back from PSE for discarding the freezer?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

BA6 In what month did you discard the freezer? **[INTERVIEWER NOTE: YOU CAN PROBE HERE WITH RANGES & SEASONS BEFORE ACCEPTING A 'DON'T KNOW' RESPONSE. STRESS THE WORD APPROXIMATELY TO THE CLIENT.**]

1 JANUARY
2 FEBRUARY
3 MARCH
4 APRIL
5 MAY
6 JUNE
7 JULY
8 AUGUST
9 SEPTEMBER
10 OCTOBER
11 NOVEMBER
12 DECEMBER

96 REFUSED
97 DON'T KNOW

BA7 In the past year did you . . .

a regularly wash clothes with cold water?
b hang laundry to dry?
c use the moisture sensor on your clothes dryer?
d tighten your refrigerator seal
e clean your refrigerator coils?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

[ASK IF YES TO ANY BA1, BA4, BA7a-e]
BA8 What, if anything, influenced you to take any of these actions we just discussed? **[DO NOT READ] [CHECK ALL THAT APPLY]**

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
9 BETTER FOR CLOTHES
10 HABIT/COMMON SENSE
11 EQUIPMENT MAINTENANCE/REGULAR CLEANING
12 FIX BROKEN EQUIPMENT
13 IMPROVE EFFICIENCY OF EQUIPMENT
14 PERSONAL PREFERENCE
15 RECOMMENDED BY MANUFACTURER/OTHER
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

BE Behavior-Electronics and Other – ASK IF BEHAVIOR SEQUENCE = 3, 4 OR 5

BE1 In the past year, did you . . .**[READ]**

a plug some equipment into power strips that you turn off when you are not using the equipment?
b install any "smart" power strips that turn off multiple items when one item is turned off?
c regularly unplug electronics when not in use?
d regularly use computer power-saving modes?
e regularly turn off your computer at night?
f install solar photovoltaic panels?

1 YES
2 NO ➔ **SKIP TO M1**
96 REFUSED ➔ **SKIP TO M1**
97 DON'T KNOW ➔ **SKIP TO M1**

[ASK IF ANY OF BE1a-f=1]
BE2 What, if anything, influenced you to take any of these actions we just discussed? [DO NOT READ. ACCEPT MULTIPLE RESPONSES.]

1 SAVING MONEY
2. SAVING ENERGY [ALSO TO BE 'GREEN' OR ENVIRONMENTALLY CONCIOUS]
3. PSE OR OTHER REBATE
4 LETTER FROM PSE
5 PSE WEBSITE, PSE ADVERTISING,
6 SALESPERSON
7 ADVERTISING, NEWS, MEDIA
8 HOME ENERGY REPORT
94 NOTHING/NO INFLUENCE
95 OTHER (PLEASE SPECIFY)
96 REFUSED
97 DON'T KNOW

M HERS Report – Response to Mailings – ASK M1-M10 OF SAMPLE GROUP 2 ONLY

M1 Did your household receive a Home Energy Report from Puget Sound Energy about your in-home energy use?

1 YES ➔ **SKIP TO M3**
2 NO
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW

M2 The Home Energy Report is sent by Puget Sound Energy, separate from your bill. It breaks down your energy use and your neighbors' energy use and highlights tips about saving energy. Do you recall receiving the Home Energy Reports?

1 YES
2 NO ➔ **SKIP TO D1**
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW ➔ **SKIP TO D1**

M3 How frequently **<2 - do/3 – did>** you receive these reports? **[READ]**

1 Monthly
2 Every other month
3 Quarterly, or
4 Annually?
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW

M4 Did you or someone else in your household read the reports?

1 YES
2 NO ➔ **SKIP TO D1**
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW ➔ **SKIP TO D1**

M4a Would you say that someone in your household read . . .**[READ]**?

1 some of the reports,
2 most of the reports,
3 or every Home Energy Report that you received?
96 REFUSED ➔ **SKIP TO D1**
97 DON'T KNOW ➔ **SKIP TO D1**

M5 About how much time did you or someone else in your household spend reading each report? **[READ] [DO NOT ACCEPT MULTIPLE REPLIES]**

1 One to three minutes,
2 Four to ten minutes, or
3 More than 10 minutes
96 REFUSED
97 DON'T KNOW

M6 On a scale of 1 to 5, where 1 is "not at all useful" and 5 is "very useful," how useful have you found the Home Energy Reports?

1 NOT AT ALL USEFUL
2
3 I
4
5 VERY USEFUL
96 REFUSED
97 DON'T KNOW

M7 Now I'm going to ask you about how useful each of the components of the Home Energy Report is. **First/Next** is the **<INSERT COMPONENT HERE>.** Is it…**[READ]**?

1 very useful,
2 somewhat useful, or
3 not at all useful?
96 REFUSED
97 DON'T KNOW

a. Last 2 Months Overall Usage Comparisons to your neighbors' energy use
b. Last 12 Months Comparison to Neighbors for Gas and Electricity
c. Comparison to your Household's Usage the Year Before
d. Action Step – Tips to Save Energy
e. Recommendations For Energy Efficient Purchases

M8 [PROGRAMMER NOTE: M8 REMOVED]

M9 Did any of the energy saving tips in the Home Energy Report cause you to adopt new energy saving habits?

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

M10 Did the Home Energy Report cause you to purchase more efficient energy using equipment?

1 YES
2 NO
96 REFUSED

97 DON'T KNOW

D DEMOGRAPHICS – ASK ALL

[READ]: I have few final questions about your household. We're almost done.

D1. Which of the following best describes the type of home you live in? Is it a… [READ]

01 Single family, detached,
02 Single family attached, such as town house or row house,
03 Apartment in multi-unit structure of 2–4 units,
04 Apartment in multi-unit structure of 5 or more units, or
05 Mobile Home?
96 REFUSED
97 DON'T KNOW

D2 Do you own or rent your home?

1 OWN
2 RENT
96 REFUSED
97 DON'T KNOW

D3. How many years have you lived in your current home?

01___ years **[IF <1 YEAR, RECORD 0]**
96 REFUSED
97 DON'T KNOW

D4**.** Approximately what year was your home built? **[DO NOT READ]**

01 2006 OR LATER
02 2000 TO 2005
03 1990 TO 1999
04 1980 TO 1989
05 1970 TO 1979
06 1950 TO 1969
07 EARLIER THAN 1950
96 REFUSED
97 DON'T KNOW

D5**.** What is the approximate finished square footage of your home? Your best estimate is fine. **[DO NOT READ]**

01 LESS THAN 1,2000 SQUARE FEET
02 1,200 TO LESS THAN 1,800 SQUARE FEET
03 1,800 TO LESS THAN 2,400 SQUARE FEET
04 2,400 TO LESS THAN 3,000 SQUARE FEET
05 3,000 SQUARE FEET OR MORE
96 REFUSED
97 DON'T KNOW

D6. What is the **primary** fuel used to heat your home? **[DO NOT READ]**
01 NATURAL GAS
02 ELECTRICITY
03 PROPANE
04 OIL
05 WOOD
06 SOLAR
96 REFUSED
97 DON'T KNOW

D7. What is the **primary** fuel used to heat your hot water (water heater)? **[DO NOT READ]**
01 NATURAL GAS
02 ELECTRICITY
03 PROPANE
04 OIL
05 WOOD
06 SOLAR
96 REFUSED
97 DON'T KNOW

D8 How many working refrigerators do you have in your home?
01 ___ RECORD NUMBER OF WORKING REFRIGERATORS
96 REFUSED
97 DON'T KNOW

D9. Including yourself and children, how many people live in your home at least six months of the year?
01___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW
[IF D9 = 96/97/1 PERSON, SKIP TO D15, ELSE ASK D10]

D10. How many people in your household, excluding yourself, are under 5 years of age?
01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

D11. How many people in your household, excluding yourself, are 5 to 17 years of age?
01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

D12. How many people in your household, excluding yourself, are 18 to 64 years of age?

01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

D13. How many people in your household, excluding yourself, are 65-79 years of age?

01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

D14. How many people in your household, excluding yourself, are 80 years of age or older?

01 ___ RECORD NUMBER OF PEOPLE
96 REFUSED
97 DON'T KNOW

[CHECK THAT D9 = D10-D14 MINUS 1]
[IF THEY DON'T ADD UP, VERIFY RESPONSES TO D10 THROUGH D14 UNTIL THEY DO]

D15 What is *your* age?

01 ___ RECORD AGE
96 REFUSED
97 DON'T KNOW

D16 What is the highest level of education you have obtained? **[READ LIST]**

1 Some high school,
2 High school graduate, including GED,
3 Some college or an Associate's degree,
4 Bachelor's degree,
5 Some graduate school,
6 Graduate or professional degree,
96 REFUSED
97 DON'T KNOW

D17 Next, for statistical purposes only, I'd like to know your household's total 2011 annual income before taxes. Please stop me when I reach the category that best describes your household's income. **[READ IF NECESSARY:** This information is confidential and will only be used for characterizing respondents to this study.] **[READ LIST]**

1 Less than $25,000,
2 $25,000 to $49,999,
3 $50,000 to $74,999,
4 $75,000 to $99,999, or
5 $100,000 or more?
96 REFUSED
97 DON'T KNOW

W WRAP UP – ASK ALL

[READ]: Those are all the questions I have for you. Is there anything that you want me to pass on to PSE? Thank you very much for your time and opinions.

YES, RECORD:_____________

NO

RECORD GENDER

1 MALE
2 FEMALE
97 CAN'T DETERMINE

D. OPOWER Home Energy Report Example

Home energy report

PSE PUGET SOUND ENERGY
The Energy To Do Great Things

REPORT PERIOD: 10/01/08 - 10/31/08
Account number: 465487100

*******AUTO**SCH 5-DIGIT 98033

ABOUT THIS REPORT This report contains information and analysis about your electricity and natural gas consumption. It includes comparisons to your neighbors to help you better understand your energy usage. We hope the information in this report helps you make smart choices to reduce your use and bills.

WHY AM I RECEIVING IT? 40,000 Puget Sound Energy customers are receiving these reports as part of a pilot program. Only you can see your personal information.

October Neighbor Comparison | You used **4% MORE** energy than your neighbors.

HOW YOU'RE DOING:
GREAT
GOOD
▶ **BELOW AVERAGE**

* This energy index combines electricity (kWh) and natural gas (therms) into a single measurement.

WHO ARE YOUR "NEIGHBORS"?

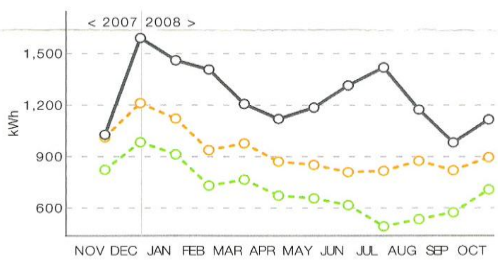
ALL NEIGHBORS
Approximately 100 occupied nearby homes that are similar in size to yours (avg 2,519 sq ft) and have both electricity and natural gas service.

EFFICIENT NEIGHBORS
The most efficient 20 percent from the "All Neighbors" group.

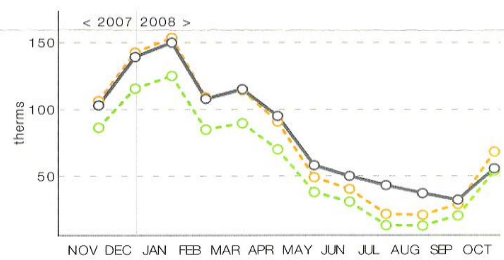
Last 12 Months Neighbor Comparison

You used **19% MORE** energy than your neighbors.
This costs you about **$409 EXTRA** per year.

Electricity | 34% more electricity than your neighbors



Natural Gas | 4% more natural gas than your neighbors



Personalized
Action Steps

- ☐ Lower the temperature of your hot water heater
- ☐ Switch to compact fluorescent bulbs
- ☐ Look for the ENERGY STAR® label

TURN OVER TO LEARN MORE

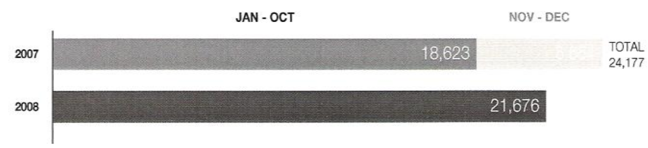
PSE-20081104-6-NUM_10-1-5-4375

Personal Comparison | How your energy use this year compares to last year.

About This Graph
This section shows how much energy you've used so far this year and compares that amount to the same period last year.

As the months go by you can see how your progress compares to last year.

Your Progress
So far this year, you've used **16% MORE** energy than last year.



* This energy index combines electricity (kWh) and natural gas (therms) into a single measurement.

Action Steps | Personalized tips chosen for you based on your energy use and housing profile

Quick Fixes
Things you can do right now

☐ **Lower the temperature of your hot water heater**
Lowering the water heater temperature from 140°F to 120°F can result in a 10% savings in hot water costs.

Most households find 120°F to be sufficient for their needs. As an added benefit, this temperature is helpful for preventing scalding.

Note that if your dishwasher does not have a booster heater, a water temperature of 130°F to 140°F may be necessary—consult your owner's manual for information.

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☐ **Switch to compact fluorescent bulbs**
Compact fluorescent light bulbs (CFLs) use 75% less energy and last up to 10 times longer than standard incandescent light bulbs. Replace a few 100-watt incandescent bulbs and start saving money now.

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Home energy report

REPORT PERIOD: 09/01/08 - 09/30/08
Account number: 465487100

PUGET SOUND ENERGY
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ABOUT THIS REPORT This report contains information and analysis about your electricity and natural gas consumption. It includes comparisons to your neighbors to help you better understand your energy usage. We hope the information in this report helps you make smart choices to reduce your use and bills.

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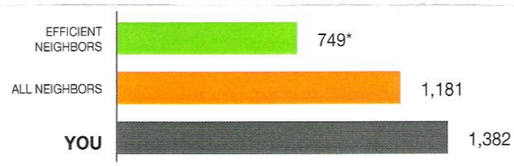
WHY AM I RECEIVING IT? 40,000 Puget Sound Energy customers are receiving these reports as part of a pilot program. Only you can see your personal information.

September Neighbor Comparison | You used **17% MORE** energy than your neighbors.



HOW YOU'RE DOING:
GREAT
GOOD
▶ **BELOW AVERAGE**

* This energy index combines electricity (kWh) and natural gas (therms) into a single measurement.

WHO ARE YOUR "NEIGHBORS"?

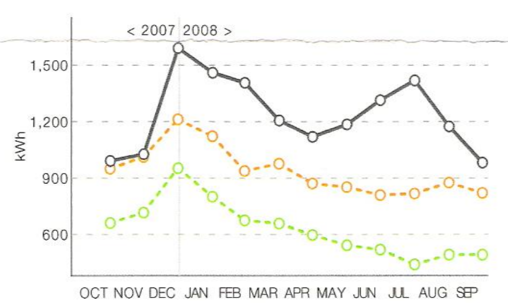
ALL NEIGHBORS
Approximately 100 occupied nearby homes that are similar in size to yours (avg 2,519 sq ft) and have both electricity and natural gas service.

EFFICIENT NEIGHBORS
The most efficient 20 percent from the "All Neighbors" group.

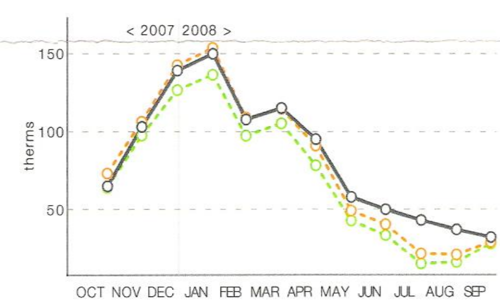
Last 12 Months Neighbor Comparison

You used **18% MORE** energy than your neighbors.
This costs you about **$397 EXTRA** per year.

Electricity



Natural Gas



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Action Steps

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Analysis of PSE's Pilot Energy Conservation Project: "Home Energy Reports"

Lawrence Berkeley National Laboratory Technical Memo

Annika Todd, Steven Schiller, Charles Goldman

October 17, 2011

Executive Summary

Overall, with respect to evaluation of energy savings, the method of program implementation and analysis for Puget Sound Energy's Home Energy Reports (HER) program was excellent and the estimates of energy savings are valid (assuming that the data were valid and that the calculations were mechanically correct). However, LBNL is in agreement with KEMA's "20 Month Impact Evaluation[1]" that the results are only applicable to the study duration (20 months) and the study population (households in King County that use more than 80MBtus and are single family homes, among other restrictions). While the analysis methods used in this pilot are very robust, the savings estimates cannot be applied directly to a full-scale rollout of the program: for the currently defined study population, a control group that does not receive HERs should be maintained, and for a different population (such as low energy users) a new control group should be established in order to correctly estimate savings.

LBNL Review of Method, Analysis, and Results

- The evaluation study design for the HER pilot program utilized a randomized controlled experiment with an opt-out design, which is the *best feasible method* of inferring that a program caused energy savings. With this method, any difference in energy use between the control and treatment groups can be attributed to the HER program. With other methods that are commonly used, it is likely that savings estimates are biased.

[1] KEMA, 2010. *Puget Sound Energy's Home Energy Reports Program: 20 Month Impact Evaluation.* Madison, WI.

- KEMA's "20 Month Impact Evaluation" (denoted KEMA's Evaluation for the remainder of this memo) presented two methods for estimating energy savings for the HER program: the "Pooled" method and the "Difference-of-Differences" method. The KEMA Evaluation used the numbers from the "Pooled" method. LBNL believes that this method may have biased estimates and definitely has erroneous confidence intervals that are too small. However, the "Difference-of-Differences" method produces unbiased, statistically significant estimates of energy savings with correctly calculated confidence intervals. Therefore, the numbers from this estimation, presented in the last two columns of Table C-1 in KEMA's Evaluation, should be used instead of the numbers presented throughout KEMA's Evaluation from the "Pooled" method. The amount of total savings over 20 months from these two models is almost identical, although the first 12 months and last 12 months differ slightly.
- Specifically, LBNL believes that Table 2 below (which is excerpted from Table C-1 in KEMA's Evaluation and reflects the "Differences-of-Differences" method) provides the most robust estimate of energy savings. Note that the 95% confidence intervals do not include zero, indicating that these results are statistically significant. Thus, these results provide strong evidence that there are actual energy savings from the HER pilot program. These savings estimates are not adjusted for weather, as discussed further below.

Table 2: Annualized Estimated Savings per Treatment Household[2]

	First 12 months (11/08-10/09)		All 20 months (11/08-6/10, annualized)		Last 12 months (7/09-6/10)	
Electric Savings	**183.2 kWh**	**1.65%**	**204.5 kWh**	**1.84%**	**225.4 kWh**	**2.03%**
95% confidence interval	*±26.3 kWh*	*±0.24%*	*±28.3 kWh*	*0.26%*	*±33.6 kWh*	*0.30%*
Gas Savings	**10.7 Therms**	**1.11%**	**12.1 Therms**	**1.26%**	**13.4 Therms**	**1.40%**
95% confidence interval	*±1.8 Therms*	*0.19%*	*±1.9 Therms*	*0.20%*	*±2.3 Therms*	*0.24%*

- KEMA's March 7, 2011 memo entitled "Home Energy Report Evaluation – Analysis of PSE's EE Program Tracking Data" (denoted KEMA's Double Counting Memo for the remainder of this memo) provides a good analysis and estimates of the magnitude of the double counted savings for programs that were tracked. Specifically, see Table 3 and Table 4 below in section 6 for double counting numbers (excerpted from KEMA's Double Counting Memo Tables 2-5). Table 3 uses a "Time of Participation" method, while Table 4 uses a "Load Shape-Allocated" method. LBNL agrees with KEMA that both methods are sound and that PSE should use whichever method it believes is appropriate from an accounting perspective.

[2] Similarly, LBNL believes that the last two columns of Table C-2 and Table C-3 in KEMA's Evaluation titled "Differences-of-Differences" provides the most robust estimate of energy savings specific to monthly vs. quarterly reports.

- In meetings with PSE staff, they indicated that they were considering deducting the double counted savings from the HER program for ease of accounting purposes, but would not deduct these savings when considering the overall effectiveness of the HER program. LBNL agrees with PSE that for accounting purposes it may not matter which program receives the double counted savings. For considering the overall effectiveness of the HER program, LBNL recommends allocating the double counted savings such that the HER program receives between 50% and 100% and the other tracked program receives between 0% and 50% of the double counted savings, as discussed further below in section 6. Without any additional information, an intermediate case might be recommended, where the HER program receives 75% of the double counted savings and the other program receives 25%. Note that if the double counted savings are entirely given to the other program, this could create a perverse incentive for OPOWER to *not* direct customers to other programs.

LBNL Recommendations for Applicability of Results to Other Populations and Future Years

- LBNL agrees with KEMA's Evaluation that these estimates of energy savings are only valid for the study population, and should not be extrapolated outside of the study population to the greater PSE territory[3]. Specifically, because the population was restricted to King County and to households that use more than 80MBtus of energy (this energy restriction cut out approximately 12-15% of households after all other restrictions were applied), the savings estimates cannot be assumed to be the same for households outside of King County or for households that use less than 80MBtus of energy.
- LBNL agrees with KEMA's Evaluation that these estimates of energy savings are only valid for the study duration (20 months), and should not be extrapolated into future years; savings should be estimated each year using actual energy data for the past year from treatment and control groups. Specifically, these estimates are only applicable to the conditions that occurred during the study period, including weather, consumer energy costs, economic conditions, etc.

LBNL Recommendations Going Forward

- In the future, LBNL recommends that a randomly allocated control and treatment group should be maintained in order to allow unbiased estimates of energy savings each year. In practice, this means that HERs cannot ever be mailed to *every* household. However, it is

[3] The study population was restricted to single family, residential homes located in King County that use more than 80MBtu of energy per year, use both natural gas and electricity provided by PSE, do not use a solar PV system, have parcel data available from the county assessor, have a bill history that starts on or before Jan 1 2007, have 100 similarly sized homes within a two mile radius, and have automatic daily meter reads.

possible that the size of the control group could be reduced in future rollouts (50% of the study population is likely not needed). Analysis should be done to determine the smallest possible control group such that the estimates are likely to be statistically significant at 5%. If the control group size is reduced, then more people can be in the treatment group, and aggregate savings are likely to be higher[4].

- If the program is to be expanded to additional populations and additional counties, LBNL recommends that a new study population is defined and new control and treatment groups are randomly assigned from within the new study population. Again, an analysis should be done to determine the smallest possible control group so that as many households as possible can be placed in the treatment group.
- In future analysis, LBNL would recommend using either a difference-in-difference model defined in section 4.3.2 below as Model 1 (which is the same as the method used to produce the "Difference-of-Differences" results in the last two columns of Table C-1 in KEMA's Evaluation), or a fixed effects regression with standard errors clustered at the household level that is not normalized for a "typical" year's weather, defined in section 4.3.2 below as Model 2. Both models lead to unbiased estimates of energy savings with correctly calculated confidence intervals. Model 1 is a more simple analysis, while Model 2 may be slightly more precise in the sense that it may have slightly smaller confidence intervals.
- In the future LBNL recommends that KEMA or PSE continues to review program tracking databases to determine participation by customers in other PSE efficiency programs in order to calculate double counted savings for these tracked programs (using a method similar to that used in KEMA's Double Counting Memo).
- LBNL recommends that PSE consider conducting survey research of customers to assess the possible impact of programs that are not tracked, such as upstream programs that cannot be traced to a specific household. For example, the analysis described in Dougherty et al. 2011[5] used surveys of individual households in order to determine the types of measures (e.g., appliances, CFLs, and weatherization) that households in a Massachusetts HER program installed.

[4] Two good references for determining the optimal control and treatment sample sizes are (1) section four in: Duflo, E., R. Glennerster, and M. Kremer. 2007. "Using randomization in development economics research: A toolkit." *Handbook of development economics* 4: 3895-3962. http://economics.mit.edu/files/806; and (2) section 4 Protocol 5 in: "Guidelines for Designing Effective Energy Information Feedback Pilots: Research Protocols*.*" EPRI, Palo Alto, CA: 2010. 1020855.

[5] Doughterty, A., Dwelley, A., Henschel, R. and Hastings, R. *Moving Beyond Econometrics to Examine the Behavioral Changes behind Impacts.* IEPEC Conference Paper.

1 Introduction and Objective

LBNL was asked by the Washington Utilities and Transportation Commission (UTC) staff to provide an independent analytical review and critique of an emerging residential energy conservation behavior-change based program sponsored by Puget Sound Energy, called the Home Energy Report (HER) program. LBNL was also asked to provide a recommendation to accept, reject, or partially accept estimates of the energy savings attributable to the HER program presented in KEMA's "Puget Sound Energy's Home Energy Reports Program: 20 Month Impact Evaluation," as well as to make recommendations for the program and the analysis going forward.

This technical memo provides LBNL's review and assessment of KEMA's Evaluation of the HER program in response to the request by WA UTC staff. In this memo, LBNL reviews both the approach used by OPOWER and PSE to set up and implement the program as well as the analysis methodology used in KEMA's 20 Month Impact Evaluation. We also discuss implications and applicability of the results, and recommendations for continuing the HER program. This memo does not verify the validity of the data used or the calculations (i.e., we did not review the SAS code used in the analysis).

This memo addresses several specific issues that are important to the overall validity of the program's energy savings and is organized as follows. In section 2, we discuss issues related to the causal inference method (the method by which the savings can be causally attributed to the program; in this case, experimental design). In section 3, we discuss data related issues. In the following sections, we discuss analysis methodology issues (section 4), the external validity of the results (section 5), and double counting issues (section 6), and the final section provides recommendations for the future (section 7). Each section begins with a general discussion of a specific issue, including why the issue is important, the best practices for addressing the issue, and the implications of addressing the issue in different ways. Each section concludes with LBNL's assessment of the method by which the HER program setup and analysis addressed each issue and the implications of the method used. The main point of LBNL's assessment of the methods used is summarized for each issue with the label "LBNL Observation"; readers could quickly skim this memo reading only these observations, adding the surrounding discussion when necessary.

2 Causal Inference Method

General Discussion

The goal of the ongoing pilot project is to be able to infer whether or not Home Energy Reports (HERs) caused energy savings over a specific amount of time for a specific population. In order to determine whether or not energy savings were caused by the HERs, it is necessary to know the energy use of the specific population in the presence of HERs and the energy use without the HERs. Ideally, we would be able to observe two parallel universes: one in which the customers received HERs, and one in which those exact same customers did not receive HERs, where the difference in energy use between the two is clearly the savings that was caused by the HERs. Because in reality a specific customer can either receive a HER or not, we can never observe the same customer in both situations for a specific time period.

Rather than observing the exact same customer in both situations, we can compare two groups of customers, one group who received HERs (the "treatment" group), and one group who did not (the "control" group). Then, any difference in energy use between the treatment and control groups comes from three sources: first, the treatment group received the HERs and the control group didn't; second, the people in the treatment group may be different than the people in the control group; and third, there is some inherent randomness. The key point is to try to minimize the differences between the people in the control and treatment groups, so that the difference in energy use can be attributed to the HER reports rather than differences between the people (statistics can then be used to determine whether the remaining differences are due to the HERs or to inherent randomness).

Randomized controlled trials (RCTs) are the best way to infer causality (if the HERs caused the observed changes in energy consumption). When customers in a defined population are randomly assigned to the treatment and control groups, the differences between the types of people in these two groups are minimized, and so any difference between the energy use of the treatment group and the control group can be causally attributed to the program. Sometimes "quasi-experimental" methods are used, in which customers in a program are compared to customers who are not in the program. The problem with this method is that these two groups may have different people in them (called "selection bias"). For example, customers who self-select into a program are obviously different types of people than those who don't, and programs are sometimes targeted to specific areas or specific demographic groups. In these examples, the difference in energy use between these two groups can be attributed both to the program and to pre-existing differences between people with these different characteristics. Even if all observable differences between the two groups are balanced or matched, there are always unobservable differences that are not matched (for example, the type of person who would sign up for a program).

Another method would be to compare the energy use of customers in a program to their own historical energy use; however, there are so many other factors that influence energy use (such as economic conditions, weather, political events, energy prices, other utility programs) that the difference between current energy use and past energy use that is attributable only to the program under consideration will always be very difficult to ascertain in a reliable and accurate manner.

Specific Implementation for the HER Program

LBNL Observation 1 *The causal inference method used in the HER Pilot Program was a randomized controlled experiment. This is the best method for causally attributing energy savings to HERs.*

The HER pilot was set up as a true randomized controlled experiment, where the treatment and control groups were randomly selected from the target population. This is the best method for inferring causality: any difference in energy use between the control group and treatment group can be attributed to the effect of the HERs (and to inherent randomness). Specifically, with randomization, the control and treatment groups should have equal proportions of both observable variables, such as income, energy use, and participation in other monitored utility programs (rebate programs), as well as unobservable variables, such as participation in non-monitored programs (CFL programs).

2.1 Randomization Design

General Discussion

There are several types of randomized controlled trial (RCT) designs, including mandatory RCT, RCT opt-out, RCT opt-in (which can be either recruit-and-delay or recruit-and-deny), crossover design, and factorial design. Mandatory RCT, in which people are randomly assigned to a control or treatment group with no option to opt-out of the treatment group, is good for determining the effect of a program but usually is not feasible. The next-best option is RCT opt-out, in which people are randomly assigned to a control or treatment group with an option to opt-out of the treatment group. In this case we can't tell how a program would affect those who opted out, but we probably don't want to force them to participate in any case. An opt-out design is better than an opt-in design because a much higher percentage of people tend to stay in an opt-out program than tend to opt-in to a voluntary program, and the types of people who tend to opt-in to a voluntary program are different than the types of people who don't opt-in to voluntary programs. RCT opt-in designs are only applicable to the type of customers who would opt-in to such a program; these customers may be a biased set of customers with different energy use characteristics than the general population.

Specific Implementation for the HER Program

LBNL Observation 2 *The experimental design used was a Randomized Controlled Trial with opt-out participants. LBNL believes that an opt-out design is the best feasible method for creating robust estimates of energy savings.*

The HER pilot project used an opt-out RCT design, where customers who were randomly allocated to the treatment group were mailed the HERs by default, and had to actively remove themselves from the program if they no longer wished to receive the report[6]. This is the second best type of design, and we believe that in most cases it is the best design that is actually feasible.

2.2 Unit of Randomization

General Discussion

The treatment and control groups can be randomized over different units, where each unit is independently assigned to either group. The unit of randomization could be an individual, a household, a block, a town, etc. There are two issues to consider. First, for statistical significance, a large number of units are needed, and a smaller unit of randomization probably means more units (it would be hard to get 500 towns to participate in a randomized program). Second, the units should be large enough so that there are no spillover or externality effects between units. For example, while randomizing over individuals would result in more units than randomizing over households, individuals within a household can be expected to significantly influence each other's behavior, resulting in spillover outside of the unit of randomization. This can severely bias results, because then it becomes unclear who is "treated" and who is not, if household members are sharing information with each other.

Specific Implementation for the HER Program

LBNL Observation 3 *The unit of randomization was the household level. LBNL believes that this is the best unit of randomization for the HER program.*

LBNL Observation 4 *Spillover effects from one unit of randomization to another (from household to household) could result in biased estimates; however, LBNL agrees with OPOWER and KEMA that these spillover effects are not expected.*

The HER pilot was randomized at the household level. LBNL believes that spillover effects between households are not expected for the following reason. Because the HER letters are specific to a household, even if a household in the treatment group who received a HER shared information with a neighbor in the control group who did not receive a HER, the neighbor would not know their own standing relative to others. It is possible the act of discussing the letter with the neighbor might get the neighbor thinking more about his own energy use and how his energy use compares with others, and cause the neighbor to save energy. However, even if this is the case, this would cause the energy use of the control group to decrease, which would mean that the savings estimates are biased downwards (i.e., this would mean that the true energy savings are higher than the estimated savings).

[6] Around 1.6% of recipients opted-out of the program in the first two years. As discussed further below, these customers were not removed from the analysis.

2.3 Study Population

General Discussion

The study population is the group of people from which the control and treatment units are randomly assigned. The study population may be a specific, targeted subset of the entire population of customers, as long as both the control group and the treatment group are randomly assigned from the specific subset (that is, the control group cannot be taken from a different subset than the treatment group). It is important to clearly define the study population, because the estimated energy savings are only valid for the subset of customers in the study population without making strong assumptions about the program. For example, if the study population is the subset of customers that are high energy users, the energy savings results cannot be expected to be the same for low energy users[7].

There are two things that affect the definition of the study population: the type of experimental design, which implicitly restricts the study population; and the screening process, which explicitly restricts the study population. With opt-in designs, the study population is restricted to the type of people that would opt-in to the program. With randomized encouragement designs, the study population is restricted to a subset called "compliant" customers. With opt-out designs, there are two cases: if those who opt-out are *not* included in the analysis, the study population is restricted to the type of people who don't opt-out; if those who opt-out *are* included in the analysis, the study population is unrestricted by the experimental design (although it is still restricted by the screening process). Opt-out designs therefore are the most desirable because they do not restrict the study population for which the results of the program are valid.

The screening process also restricts the study population. Often the screening process restricts the study population to specific geographies (zip codes or service areas), specific demographics (low income, medical needs, elderly), specific customer characteristics (high energy users, dual fuel use, length of customer bill history), specific data requirements (census information is available, smart meter installed), and other restrictions. The choice of how to restrict and screen the study population is important. On one side, restricting the population means that the study's result can't be extrapolated outside that specific group. On the other side, it may be the case that the program works better for a certain subset of the population, and in this case it is more cost effective to limit the study population to this subset. Another reason to restrict the study population is for statistical precision; the more similar the households in the study group, the lower the variation in energy use, and the more precise the estimates become.

[7] In this case, one could make the assumption that low energy users would react to the HERs in the same way that high energy users would react, but this is a fairly strong assumption that is likely not true. On the other hand, if the study population were defined with a factor that is irrelevant to how people are likely to react to HERs, such as choosing the study population to be only those with blue eyes, then it is a weaker assumption to assume that people with brown eyes react in the same way as people with blue eyes (although it is still an assumption).

Specific Implementation for the HER Program

LBNL Observation 5 *The study population was restricted to customers that meet the following criteria: use dual fuel, are a single family residential home, are located in King County, use more than 80MBtu of energy per year, do not utilize a solar PV system, have an address that is available with parcel data from the county assessor, have a bill history that starts on or before Jan 1 2007, have 100 similar sized homes within a two mile radius, have automatic daily meter reads, and are not in the 98006 zip code. Because the experimental design is opt-out and the customers who opt-out are included in the analysis (as discussed further below), the study population is not further restricted by the type of experimental design.*

The HER pilot used an opt-out experimental design and included customers who opted-out in their analysis, which is the most conservative approach that places no implicit restrictions on the study population. The explicit screening process does restrict the study population to homes as described above. Some of the restrictions are for data purposes (bill history, parcel data), and some are to reduce variation in type of customer (excluding those who have a solar PV system). LBNL believes that all of these are valid restrictions, although as noted, the energy savings calculated for this pilot program should not be extrapolated outside of this defined, restricted study population.

2.4 Study Duration

General Discussion

The study duration is the length of time that the original, randomly allocated treatment group receives the program and the control group does not receive the program. It does not include any time during which baseline data is collected. The estimates of energy savings due to the program are only valid for the study duration, and cannot be extrapolated outside of the study duration to future years without making strong assumptions about the program.[8]

Specific Implementation for the HER Program

LBNL Observation 6 *The study duration evaluated in the KEMA Evaluation is 20 months.*

The HER pilot program is being evaluated over a study duration of 20 months, but the study will continue as originally designed with a treatment and control group into the future. A three year evaluation is planned.

[8] As discussed below, there are many reasons why we might expect the energy savings from the HER program to increase, decrease, or stay the same. So far, the KEMA report has shown an upswing in savings in the second year relative to the first year.

2.5 Stratification

General Discussion

Sometimes programs employ a stratified sampling method when restricting the study population or when randomizing units into treatment and control groups. This is done to make sure that a sub-population of interest is represented by enough units to be able to make statistical conclusions about the program effectiveness for that sub-population; however, it requires a specific type of analysis.

Specific Implementation for the HER Program

LBNL Observation 7 *Stratification was not performed in the selection of the study population or in the randomization of households into treatment and control groups.*

Because stratification was not used, it does not need to be corrected for in the analysis.

3 Data

This section describes data collection, data cleaning, and data sampling methods.

3.1 Data Collection

Data that are appropriate for the program and the type of analysis desired should be collected.

LBNL Observation 8 *LBNL believes that data appropriate for the type of analyses performed were collected.*

For the HER program, the collected data include: household energy usage data, frequency of report delivery, household square footage and other household characteristic data. Household usage data were collected by automated CellNet meters for each home included in the participant and control groups, and the data were gathered on daily intervals. County assessor data were used to identify home values, household square footage, and identify neighboring homes.

3.2 Data Cleaning

The way in which data are cleaned (removing outliers or missing observations) can have a relatively large impact on the estimates in the analysis. There should be a clear methodology for cleaning data that is based on knowledge of the industry or of the data collection process.

LBNL Observation 9 *There was a clear methodology for cleaning the data: electric reads greater than 300kWh per day and less than 2 kWh per day were excluded from the sample. Gas reads greater than 100Therms per day and less than 0Therms per day were* *also excluded from the sample. Data for households that did not have usable zip codes were excluded. LBNL agrees that this methodology for cleaning data is appropriate.*

Data for households that closed accounts or opted-out of the program are discussed below.

3.3 Data Sampling

If the entire dataset is not used in the analysis for any reason, it is important to ensure that the sample of data used is a typical sample that is not biased in any way.

LBNL Observation 10 *All of the data were used; no data sampling took place. LBNL believes that this is the best way to create robust estimates of energy savings.*

4 Analysis Method

This section discusses the method used to analyze the dataset.

4.1 Balanced Randomization Check

General Discussion

If a population is large enough and is randomly assigned to a treatment and control group, then in theory the treatment group should have the same distribution of household characteristics as the control group. In practice, it is a good idea to check to make sure that this is true. Of course, only the observable characteristics of households can be tested.

Specific Implementation for the HER Program

LBNL Observation 11 *The treatment group was not found to be statistically significantly different than the control group when considering multiple household characteristics such as energy use, age of house, income, number of occupants, number of rooms, square feet, and whether the home is owned or rented, as shown below in Table 1. LBNL agrees with KEMA that this is sufficient evidence that the randomization was balanced and that therefore estimates of energy savings were not biased by differences between the two groups.*

KEMA tested each of the household characteristics listed below in Table 1 below to determine whether the mean of each characteristic was statistically different between the control and treatment group. For example, the mean electricity use in July 2007 was 853.3 for the treatment group, and was 854.8 for the control group. KEMA tested whether these two numbers were statistically significantly different than each other, and found that they were not, indicating that the control and treatment groups were not significantly different with respect to mean electricity use in July 2007. Specifically, if the p-value, which is the number in the last column labeled "Pr > |t|" is less than 0.0012 (which is 0.05 level of significance divided by the number of tests, 41), then there should be some concern that the treatment and control groups are significantly different for that specific characteristic. For July 2007 mean energy use, the p-value is 0.6472, well above this cutoff. KEMA repeated this analysis for each of the characteristics listed, and found that every single one of the p-values is much higher than the cutoff of 0.0012; none of them is below 0.15, indicating that there is strong evidence that the HER program treatment and control groups are balanced along characteristics that are observable. There is always some risk that the unobservable characteristics are imbalanced and could cause bias in results, but we believe that this risk is very small because of the large-scale randomized controlled design of the study.

Table 1: Test of Balanced Sample (Reproduced from Table A-1 in KEMA's Evaluation)

Testing for a Balance Treatment/Control Sample,
Individual Characteristic T-Tests

Characteristic	Treatment			Control			Difference	Pr > |t|
	Count	Mean	SE	Count	Mean	SE		
elecuse01JUL07	31,618	853.3	2.4657	40,006	854.8	2.2023	1.5136	0.6472
elecuse01AUG07	31,618	823.3	2.2955	40,006	823.6	2.0527	0.3203	0.9172
elecuse01SEP07	31,618	818.4	2.1534	40,006	820.1	1.927	1.7035	0.5558
elecuse01OCT07	31,618	920	2.3835	40,006	920.1	2.1152	0.1114	0.9721
elecuse01NOV07	31,618	998.1	2.6461	40,006	997.9	2.3092	-0.1528	0.9652
elecuse01DEC07	31,618	1217.8	3.3869	40,006	1218.1	2.9601	0.2409	0.9572
elecuse01JAN08	31,618	1105.8	3.0973	40,006	1103.8	2.6998	-2.0404	0.6187
elecuse01FEB08	31,618	947.2	2.6114	40,006	946.1	2.2945	-1.0043	0.7723
elecuse01MAR08	31,618	979.5	2.6819	40,006	980.5	2.3549	1.0055	0.7778
elecuse01APR08	31,618	877	2.3715	40,006	878.6	2.1034	1.5232	0.6308
elecuse01MAY08	31,618	838.1	2.2139	40,006	839.1	1.9748	1.0093	0.7338
elecuse01JUN08	31,618	810.7	2.169	40,006	812.5	1.9421	1.744	0.5495
gasuse01JUL07	31,619	18.931	0.093	40,007	18.9908	0.0848	0.0598	0.6358
gasuse01AUG07	31,619	20.0447	0.1074	40,007	20.0577	0.0965	0.0129	0.9287
gasuse01SEP07	31,619	32.4092	0.1128	40,007	32.4774	0.0954	0.0682	0.6426
gasuse01OCT07	31,619	76.1233	0.1676	40,007	76.1525	0.1481	0.0292	0.8959
gasuse01NOV07	31,619	110.7	0.2154	40,007	110.8	0.1898	0.0586	0.838
gasuse01DEC07	31,619	143.8	0.2686	40,007	143.9	0.2382	0.0627	0.8613
gasuse01JAN08	31,619	157.4	0.2879	40,007	157.4	0.2542	-0.0533	0.8895
gasuse01FEB08	31,619	114.7	0.2178	40,007	114.5	0.1915	-0.1657	0.5673
gasuse01MAR08	31,619	119.3	0.2304	40,007	119.4	0.2036	0.072	0.8146
gasuse01APR08	31,619	92.2053	0.189	40,007	92.2316	0.1674	0.0263	0.917
gasuse01MAY08	31,619	50.0173	0.1288	40,007	49.9791	0.112	-0.0383	0.822
gasuse01JUN08	31,619	41.1993	0.1248	40,007	41.1959	0.1091	-0.00343	0.9835
age	31,620	30.9307	0.0887	40,007	30.9408	0.0797	0.0101	0.9325
bedrooms	31,583	3.5499	0.00404	39,941	3.5449	0.0036	-0.00496	0.3595
bathrooms	31,620	2.2814	0.00329	40,007	2.2842	0.00293	0.00278	0.5281
fireplace	31,620	0.9569	0.00114	40,007	0.9549	0.00104	-0.00199	0.1975
house_value	31,614	347022	956.6	40,003	348235	869.5	1213.5	0.3491
income1	31,620	0.013	0.000636	40,007	0.012	0.000544	-0.00097	0.2452
income2	31,620	0.00794	0.000499	40,007	0.00787	0.000442	-0.00006	0.923
income3	31,620	0.0165	0.000716	40,007	0.0162	0.000631	-0.00028	0.7692
income4	31,620	0.0252	0.000881	40,007	0.0235	0.000758	-0.00163	0.1597
income5	31,620	0.0307	0.00097	40,007	0.0307	0.000862	-0.00001	0.9915
income6	31,620	0.1087	0.00175	40,007	0.1064	0.00154	-0.00228	0.3269
income7	31,620	0.1254	0.00186	40,007	0.1248	0.00165	-0.00062	0.8042
income8	31,620	0.1267	0.00187	40,007	0.1254	0.00166	-0.00131	0.5987
income9	31,620	0.4222	0.00278	40,007	0.4261	0.00247	0.0039	0.2944
num_occ	27,706	2.2168	0.00638	34,924	2.2287	0.00573	0.0118	0.1674
owned	27,706	0.9749	0.00094	34,924	0.9751	0.000834	0.000238	0.8495
sqft	31,620	2150.8	3.5589	40,007	2151.9	3.191	1.1429	0.8112

4.2 Attrition

General Discussion

Several types of attrition can happen throughout the duration of a program. People can opt-out of a program but still generate data after they've opted-out, as is the case with utility programs (unless the design is mandatory, in which case they can't opt-out); people can disqualify during the program (by installing a solar PV, for example); and people can exit the program in such a way that their data is no longer available (for example, utility customers who move or close their accounts).

For those who opt-out but data are still available, including these people in the analysis is the most conservative method. Excluding them could lead to biased estimates, as it is likely that people who opt-out of a program are doing so because the program isn't working for them. If they are excluded, then the study population is restricted further to the type of people who don't opt-out of the program, and estimates of energy savings are only valid for this population.

For those who exit the program in such a way that data are no longer available, it is probably the case that these people exited for a reason other than the program, and so most likely people exited in the same rate from the treatment and control groups. An analysis can be done comparing characteristics of those who exited to make sure that the treatment and control groups are balanced. If the groups are balanced, the best way to deal with these people is to exclude them and all data derived from them entirely.

Specific Implementation for the HER Program

LBNL Observation 12 *The energy data for households that opted-out (around 1.6% of households) are included in the analysis (energy data for these customers is still available after they opt-out). LBNL agrees with KEMA that this is the best choice: it is a conservative way to estimate savings, and the estimates of energy savings are applicable to the entire study population rather than only to the types of customers that do not opt-out.*

LBNL Observation 13 *Data for households that exited the treatment or control group due to account closure or moving such that energy data was no longer available (roughly 10%) were excluded entirely. KEMA's analysis found that the distribution of these households in the control and treatment groups was "approximately balanced". LBNL therefore agrees with KEMA that excluding these data most likely had no effect on the analysis.*

KEMA's Evaluation includes data from customers who opted-out. This means that the estimate of energy savings can be interpreted as the savings due to placing a customer in the treatment group in the HER program (regardless of whether they later opt-out or not).

Another choice would be to exclude customers who opt-out, in which case the interpretation would be the savings due to receiving a HER. This would most likely result in a higher estimate of energy savings because it excludes the types of people who went out of their way to opt-out of the HER program. However, this measure is not as useful from a policy perspective because it only measures the effect of the HER program on a specific sub-population (those who are not the type of people who opt-out), rather than the effect of the HER program on the population for which the program was originally intended. LBNL therefore agrees with KEMA's choice of including the opt-out customers in their analysis.

4.3 Model Selection for Estimating Energy Savings

General Discussion

There are several different analysis methods and models to choose from. The goal of any of these analyses is to create an estimate of energy savings due to the program that is: (1) unbiased, so that it does not under- or over-estimate the energy savings; (2) is internally valid, meaning that it is valid and unbiased for the given study population and given study duration; and (3) is as precise as possible, meaning that the 95% confidence intervals and the standard errors are correctly estimated and are reasonable (more on this below). The next section discusses precision, and the following section presents two models, both of which lead to unbiased estimates of energy savings attributable to a program.

4.3.1 Precision, Confidence Intervals, and Standard Errors

Recall from the beginning of this memo that with a randomized controlled trial, any energy savings for the treatment group relative to the control group can be attributed to three sources: first, the treatment group received the program while the control group did not; second, people in the control group may be different than the people in the treatment group; and third, there is some inherent randomness. We are interested in the first of these sources, which is measuring the energy savings attributable to the program. The energy savings attributable to the second source is minimized by using a randomized controlled trial design (and verifying that the groups are balanced), and so we are left with trying to ascertain how much of the savings is attributable to the first source (i.e., attributable to the program), and how much is attributable to the third source (i.e., attributable to inherent randomness). This section discusses the third source.

Consider the following example. Suppose there are only two households. The energy use of one household is likely to be quite different from the energy use of the other household, because each household has some inherent randomness in the way that they consume energy: the houses may be different sizes, have different appliances, or have different attitudes towards energy; one house may have been on vacation or may have hosted a large event; and there may be many other random differences. Suppose further that one of these two households is labeled a treatment household and receives the HER program, and that the other household is labeled a control household, and does not receive the HER program. If the treatment household is found to have used 2% less energy compared to the control household, some of the difference in energy use may be due to the program, but it is likely that most of it is due to this inherent randomness in energy use. In this case, the estimate of 2% energy savings due to the program is not very *precise* because the true energy savings could be much higher or much lower than 2%.

So what we are really interested in is a *point estimate* of the energy savings (2% in this example) together with a *95% confidence interval*, which is the interval within which we are 95% certain that the true energy savings lies. For this example, it may be that the 95% confidence interval is (-8%,12%), meaning that with 95% probability, the true energy savings due to the program is somewhere between negative 8% and 10%. The 95% confidence interval is based on the *standard error* of the point estimate, where a confidence interval is roughly the point estimate plus or minus two standard errors. Standard errors are a measure of the inherent randomness of the data being measured, and take into account both the randomness of each unit and the randomness of the total number of units being measured. If there are more units, the standard errors decrease, and if there is less individual randomness in each unit, the standard errors decrease. Here, we will say that an estimate is more *precise* if it has smaller standard errors and therefore a smaller confidence interval.

Now suppose that we have 100,000 households in each group. With this many people, the inherent randomness in each household's energy use tend to balance each other out, and so the inherent randomness of the 100,000 households as a whole is smaller. This means that the standard errors and the confidence interval are smaller than in the case with only two households, and the estimate of energy savings is more precise[9].

Statistical Significance

While it is informative to know the confidence interval around a point estimate, often a binary decision has to be made: to either accept the estimate of energy savings (and therefore attribute that savings to the program), or don't accept the estimate. It is therefore useful to have a rule to use. Convention among scientists is to say that if the 95% confidence interval does not include zero, the estimate is statistically significant at 5% and the estimate should therefore be accepted.

While increasing the requirement to being statistically significant at 1% (or equivalently, that the 99% confidence interval doesn't include zero) would lead to more certainty about the estimate, it also increases the risk that an estimate of energy savings is rejected when in fact there are true energy savings. In practice, a requirement of 1% statistical significance would mean that programs would have to increase the number of people in a control group in order to sufficiently reduce standard errors, leading to fewer people in the treatment group and therefore lower total energy savings: in effect, it would increase the cost of the program.

Clustered Standard Errors

Returning to the example in which there are only two households, now imagine that 100 months of energy data were collected for each household. One way of analyzing this data is to assume that for each household, each month's energy use is independent of any other month's energy use, so that

[9] This is known in probability theory as the law of large numbers.

recording 100 months of data for one household is the same as recording data for 100 households for one month each. This would mean that the standard errors would decrease, because there are now effectively 200 total households.

However, energy use for one household is clearly not independent across the months: if the household uses a small amount of energy in one month relative to others, perhaps because it is a small apartment, then they are likely to use a relatively small amount of energy in the following months (this is called *serial correlation*). Therefore, analyzing the data as if it is independent in each month (acting as though there are 200 total households when in fact there are only 2) leads to erroneous, misleadingly small standard errors and confidence intervals[10]. On the other hand, it must be true that 100 months of data for two households contains more information than one month of data for two households.

There are two easy solutions to this serial correlation problem. The first solution, which works well when there are more than around 50 units (households in this case), is to use *standard errors that are clustered at the unit of randomization* in an analysis that uses data for each unit over time (such as a fixed effects method, discussed below). This method is easily implemented in most statistical packages.[11] Clustering standard errors essentially estimates the degree of independence in the data for each household over time and incorporates that into the standard errors: it uses all of the extra information available from having the multiple months of data, but also doesn't assume that each month is a completely separate household.

The second solution is to use a difference-in-difference model where the data are aggregated (described in more detail below). Basically, if there are 100 months of data for each household, this method averages over those 100 months so that there is one number for that household (its average energy use over 100 months). In this case, since we are collapsing 100 months into one average month, we don't have to worry about the data points being serially correlated over time. On the other hand, this method doesn't take into account the extra information that may be available in having 100 months rather than one average month. Therefore the standard errors (and the confidence interval) from a difference-in-difference model may be slightly larger than those from a model that uses the information from all of the months, such as the fixed effects model with clustered standard errors (described below). Even if they are slightly larger, the standard errors from a difference-in-difference model are much better than standard errors from a model in which the standard errors are *not* clustered (which can be three or more times smaller than the true, clustered standard errors).

[10] For a description of this effect with an example in which standard errors more than double, see: M. Bertrand, E. Duflo, and S. Mullainathan, "How Much Should We Trust Differences-in-Differences Estimates?*," *Quarterly Journal of Economics* 119, no. 1 (2004): 249-275. http://econ-www.mit.edu/files/750

[11] See, for example, footnote #24 on page 271 of the above, http://econ-www.mit.edu/files/750

4.3.2 Two Unbiased Models

Next we turn to two specific models. The first type of model, which is the easiest computationally (that is, it takes the least time for a statistical package such as Stata or SAS to run), is a difference-in-differences model where the data are aggregated in such a way that there are only four numbers: (1) energy use, averaged over all people in the control group over 12 months before the program started, denoted by E(control, 12 months before); (2) energy use, averaged over all people in the treatment group over 12 months before the program started, denoted by E(treatment, 12 months before); (3) energy use, averaged over all people in the control group over 12 months after the program started, denoted by E(control, 12 months after); and (4) energy use, averaged over all people in the treatment group over 12 months after the program started, denoted by E(treatment, 12 months after). The effect of the program over the 12 months since the program started is estimated by calculating how much the treatment group changed their energy use relative to how much the control group changed their energy use:

Model 1:

Savings= [E(treatment, 12 months before)-E(treatment, 12 months after)] - [E(control, 12 months before)-E(control, 12 months after)]

Standard errors are calculated using a t-test

Note that this method relies on the assumption that the program begins for every control and treatment household that is being analyzed at the same time. For example, if the treatment coincides with the billing cycle and billing cycles are different for different households, then Model 1 is not appropriate and should not be used; instead, Model 2 below should be used.

The time period can be changed to 15 months or 3 months or any amount of time, as long as it's the same for all four numbers. Standard errors are calculated using a t-test (although a regression method can also be used). This model is relatively intuitive, gives an unbiased estimate of energy savings, and is internally valid, but it may have lower precision than other models for two reasons: first, it doesn't control for the inherent variability in energy use in different times of the year; and second, because the energy use is averaged over the 12 months, it doesn't use all of the information provided by the energy use in each month.

The second type of model, a fixed effects model, is more precise because it controls for the inherent variation of energy use in different times of the year and uses the energy information in every month, but it is computationally more difficult. It includes what are called unit-specific fixed effects for each unit *i* (if the unit of randomization is a household, these are household-specific fixed effects for each household *i*), and time fixed effects, which could be daily fixed effects, month-of-year fixed effects (where there are twelve fixed effects, and the effect for January is measured for every January that occurs in the sample), month-of-sample fixed effects (where there are as many fixed effects as there are months in the sample, and the effect for January of one year is estimated separately from the effect for January of another year), or another type of time effect. Consider Model 2 below which has three slightly different variants. In this model a unit is assumed to be a household, and energy use is assumed to be collected on a monthly basis:

Model 2:

*(2a) EnergyUse(i,t) = a(i)+G*Post(t) +B*Treatment(i,t)+error(i,t)*

*(2b) EnergyUse(i,t) = a(i)+g(month-of-year)+G*Post(t)+B*Treatment(i,t)+error(i,t)*

(2c)[12] *EnergyUse(i,t) = a(i)+g(month-of-sample)+B*Treatment(i,t)+error(i,t)*

Where EnergyUse(i,t) is household i's energy use during month t, a(i) is a household-specific fixed effect, g(month-of-sample) and g(month-of-year) are time fixed effects, Post(t) takes the value 1 in months after the treatment begins for all households and 0 otherwise, Treatment(i,t) takes the value 1 if customer i is being treated during time period t and takes the value 0 otherwise, error(i,t) is an error term, B is the coefficient of interest, and standard errors are clustered at the household level.

With any of the specifications in Model 2, a regression will give an estimate of B which can be interpreted as follows: a household that is in the treatment group saves B units of energy per month on average relative to a household in the control group (assuming B is negative). Because the design was a randomized controlled experimental design, we can *causally* assign this savings to the program, and so the interpretation becomes: the program *causes* B units of energy to be saved per month per household that was in the program on average (assuming B is negative). This estimate is an unbiased estimate of energy savings over the period that is being analyzed for the given study population.

Because both Model 2 and Model 1 are unbiased, they should both result in the same estimate of energy savings, but Model 2 may be slightly more precise than the Model 1; Model 2 will have a slightly smaller confidence interval and slightly smaller standard errors (assuming that the standard errors are clustered at the unit of randomization). If the standard errors are not clustered at the unit of randomization, Model 2 gives an unbiased estimate of energy savings, but it will report incorrect standard errors and confidence intervals that appear to be much smaller than they actually are.

While all of the variants in Model 2 (2a, 2b, and 2c) will give unbiased estimates of B, (2b) may be slightly more precise than (2a) but will be slightly more computationally arduous because it includes twelve extra dummy variables, and (2c) may be slightly more precise than (2b) but will include even more dummy variables.

Adding Extra Variables

There are two cases of models that add additional variables to Model 2. In the first case, only *control variables* are added in an attempt to increase the precision even more (by reducing the standard errors and the confidence intervals). These control variables could include weather variables, such as heating degree days and cooling degree days or average temperature, or any other variable that changes over time. Control variables enter into the equation in Model 2 as a coefficient times the variable, so for example, *EnergyUse(i,t) = a(i)+g(f(t))+B*Treatment(i,t)+C*HDD(i,t)+error(i,t)* where C is the coefficient

[12] If there are 12 or fewer months, then (2c) should be used rather than (2b), because in that case Post(t) is not identified.

and HDD(i,t) is the heating degree days for customer i in time period t. Adding extra control variables probably won't cause bias in the estimated savings as long as too many aren't added.

The second case is adding *interaction variables* that enter into the equation in Model 2 as a coefficient times some variable *times the treatment variable*, so: *EnergyUse(i,t) = a(i)+g(f(t))+B*Treatment(i,t)+D*HDD*Treatment(i,t)+error(i,t)* , where HDD*Treatment(i,t) is an interaction variable because it describes the interaction between the two multiplied variables. While this type of model can be used to answer interesting questions about the program (in this example, estimating the coefficient D might tell us that the program works especially well on hot days), if the assumptions made in the model are not correct (in this case, that each additional heating degree day increases the effect of the program in a linear way), it could bias the estimate that we are actually interested in, which is the basic estimate of energy savings. On the other hand, if the assumptions that the model makes by including those variables is absolutely correct, then it would give an estimate of the energy savings that is exactly the same as a model that doesn't include the interactions.

Therefore a model with interaction terms should only be estimated as an *additional* analysis in order to gain deeper understandings about the program, but should not be used to estimate the basic energy savings.

Weather Normalization

We will now discuss the addition of specific interaction variables: those that are intended to normalize energy savings by weather. If the purpose of the analysis is to create a predictive model in which the program's impact in future years can be calculated simply by plugging in the future years' conditions (typically, HDD and CDD), then it might be worth including various interaction variables and testing their functional form.

However, creating a predictive model is not the primary objective. We have energy data from the control and treatment groups and so we can estimate the *actual* savings that occurred in the past year or past two years. Estimating the *actual* savings is much more precise than plugging weather variables into a model that predicts savings. Perhaps in the future, when there are 10 years of data for multiple behavioral programs in multiple areas, a predictive model like this could be of use (although such a predictive model should also include other factors that impact energy such as economic conditions).

Specific Implementation for the HER Program

LBNL Observation 14 *The KEMA Evaluation presents the "Pooled Specification Model" (described in their report on pages B-3 through B-7) as their preferred method for calculating energy savings, and results from this model are used throughout their evaluation. However, LBNL recommends that this model is not used. It is a fixed effects model in the form of Model 2 above, but it (a) includes multiple interaction variables, potentially leading to biased estimates, and (b) does not cluster the standard errors at* *the unit of randomization (the household level), resulting in incorrect, misleadingly small confidence intervals.*

LBNL Observation 15 *The KEMA Evaluation also presents the "Difference-of-Differences" model (described in their report on pages B-1 and B-2). LBNL agrees with KEMA that this model results in unbiased estimates of energy savings, with correctly calculated standard errors and confidence intervals. The results from this model provide strong evidence that the HER program resulted in actual savings. LBNL therefore recommends that the energy savings estimates from this model should be used.*

LBNL Observation 16 *The HER reports were mailed at the same time to every customer in the study population. LBNL therefore agrees with KEMA that the "Difference-of-Differences" model is well defined.*

LBNL Observation 17 *Specifically, LBNL believes that Table 2 below (which is excerpted from Table C-1 in KEMA's Evaluation and reflects the "Differences-of-Differences" method) provides the most robust estimate of energy savings. Note that the 95% confidence intervals do not include zero, indicating that these results are statistically significant. Thus, these results provide strong evidence that there are actual energy savings from the HER pilot program. These savings estimates are not adjusted for weather.*

Table 2: Annualized Estimated Savings per Treatment Household[13]

	First 12 months (11/08-10/09)		All 20 months (11/08-6/10, annualized)		Last 12 months (7/09-6/10)	
Electric Savings	**183.2 kWh**	**1.65%**	**204.5 kWh**	**1.84%**	**225.4 kWh**	**2.03%**
95% confidence interval	*±26.3 kWh*	*±0.24%*	*±28.3 kWh*	*0.26%*	*±33.6 kWh*	*0.30%*
Gas Savings	**10.7 Therms**	**1.11%**	**12.1 Therms**	**1.26%**	**13.4 Therms**	**1.40%**
95% confidence interval	*±1.8 Therms*	*0.19%*	*±1.9 Therms*	*0.20%*	*±2.3 Therms*	*0.24%*

Most of the estimates of energy savings cited in KEMA's report come from the "Pooled Specification Model", given by:

"Pooled Specification Model" from pages B-3 through B-7:

*EnergyUse(i,t) = a(i)+g(month-of-sample)+B*Treatment(i,t)*

*+C1*HDD(i,t)+C2*CDD(i,t)+D1*HDD(i,t)*Treatment(i,t)+CDD(i,t)*Treatment(i,t) + error(i,t)*

[13] Similarly, LBNL believes that the last two columns of Table C-2 and Table C-3 in KEMA's Evaluation titled "Differences-of-Differences" provides the most robust estimate of energy savings specific to monthly vs. quarterly reports.

Where EnergyUse(i,t) is household i's energy use during month t; a(i) is a household specific fixed effect; g(month-of-sample) is a time fixed effect; HDD(i,t) and CDD(i,t) are heating and cooling degree days, respectively; Treatment(i,t) takes the value 1 if customer i is being treated during time period t and takes the value 0 otherwise; and error(i,t) is an error term.

Standard errors are NOT clustered at the unit level.

Note that although the specification in the report includes additional variables, these variables are not identified and were actually excluded in KEMA's analysis, and so this represents the model that was actually estimated.

Notice two features of this "Pooled Specification Model": first, it includes both extra control variables, which are labeled above with coefficients C1 and C2, as well as extra interaction variables, which are labeled above with coefficients D1 and D2; second, the standard errors are not clustered. The extra interaction variables can lead to a biased estimate of energy savings, as discussed above, and standard errors that are not clustered can lead to erroneous, misleadingly small standard errors and confidence intervals. Therefore, while this model can provide some interesting insights into the HER program, such as whether HERs result in higher savings on hotter days, we believe that the basic estimation of total energy saved due to HERs should not be based on this model.

Instead, LBNL believes that the basic energy savings estimates due to the HER program should be based on the results from the "Difference-of-Differences" model described on page B-1 and B-2, which is the same as Model 1 above. The "Difference-of-Differences" approach results in unbiased estimates of energy savings, with correctly calculated standard errors and confidence intervals (these results are given in the last two columns of Table C-1, titled "Difference-of-Difference"). It is possible that the precision of the estimates from the "Difference-of-Difference" model may be slightly improved (that is, the standard errors and confidence intervals may be slightly reduced) by using Model 2 above to estimate energy savings (where *all* of the features of Model 2 are adhered to, including clustered standard errors and no additional interaction variables); however, this was not done in the current analysis.

The reason given in KEMA's Evaluation for including the extra interaction variables in the "Pooled Specification Model" was described to be (from page B-4 in their report): "the savings should be put on a typical year basis, so that savings do not reflect consumptions pattern from an evaluation timeframe defined by atypical weather." As discussed above, while this approach might be useful when trying to predict *future* energy savings, the quantity that we are interested in is the best estimate of *past* energy savings: the *actual* savings that occurred in the previous year (or previous 20 months). In other words, we are not interested in coming up with estimates of energy savings in a typical year, because likely there are no "typical" years with a program such as HER. Energy savings due to HERs could increase or decrease over time and so trying to predict energy savings for *typical* years in the *future* is probably unreliable and unrealistic. Instead, we are interested in coming up with estimates of energy savings that actually occurred in the previous year due to HERs, given the weather (and the economic climate and the current events, etc) that actually occurred: Model 1 or Model 2 above is the best way to do this.

LBNL Observation 18 *LBNL recommends that models that estimate energy savings for a "typical" year are not used; instead, estimates of actual energy savings based on data from previous years should be used. We do not believe that there is enough evidence to suggest that a HER program has a "typical" year of energy savings[14].*

Note also that the presence of a control group completely controls for all possible weather effects, including HDD and CDD and any other weather event (snowstorms, humidity, etc), as well as any other non-weather events that happen (the super bowl, a stock market crash, etc).

4.4 Robustness Checks

It is usually a good idea to check the robustness of a model by changing some of the assumptions, re-estimating the effect of interest, and then thinking about why the results might be different.

LBNL Observation 19 *The KEMA Evaluation presented results from two different models. Despite the issues discussed above, the estimates for energy savings with the two models were relatively close to each other. LBNL believes that this indicates that the energy savings estimates are robust. This provides further evidence that the HER program results in actual energy savings.*

5 External Validity: Applicability of Results to Other Populations and Future Years

This section discusses external validity, or the extrapolation of savings estimates outside the study duration to future years, and outside the study population to other populations.

General Discussion

In general, results cannot be extrapolated beyond the study duration or outside of the study population. That is, even if energy savings have been estimated in an unbiased way for one year for a subset of people, it does not mean that those same energy savings will appear in a second year or for a different subset of people. Many other changes occur over time that can influence energy use, and so assuming that a program works the same way in future years is a very strong assumption. Likewise, different people are likely to react to programs in different ways, and assuming that all people will react to the program in the same way is a very strong assumption.

Specific Implementation for the HER Program

[14] In fact, the estimates of energy savings appear to have *increased* from year one to year two; if this trend continues, creating a "typical" year's savings would severely underestimate the actual energy savings.

LBNL Observation 20 *LBNL agrees with KEMA's Evaluation that these estimates of energy savings are only valid for the study population, and should not be extrapolated outside of the study population to the greater PSE territory*[15]*. Specifically, because the population was restricted to King County and to households that use more than 80MBtus of energy (this energy restriction cut out approximately 12-15% of households after all other restrictions were applied), the savings estimates cannot be assumed to be the same for households outside of King County or for households that use less than 80MBtus of energy.*

LBNL Observation 21 *LBNL agrees with KEMA's Evaluation that these estimates of energy savings are only valid for the study duration (20 months), and should not be extrapolated into future years; savings should be estimated each year using actual energy data for the past year from treatment and control groups. Specifically, these estimates are only applicable to the conditions that occurred during the study period, including weather, consumer energy costs, economic conditions, etc.*

It may be the case that the effect of HERs increases over time, as customers become more conscious of their energy use and form energy conserving habits, or it may be the case that the effects decrease over time, as people become inured to receiving the letters. In either case, assuming that future savings are the same as past savings is risky and probably not true.

Similarly, results for customers that are not in the current study population (low energy users, multi-family homes, etc.) should not be expected to be the same as the results for the current study population.

6 Double Counting

6.1 Other Programs That Are Tracked

General Discussion

Consider the following example, while assuming that participation in other programs can be tracked for each household. In addition to the HER program, there is a CFL rebate program. People must enter their address to receive a CFL rebate, so it is known with certainty which households used the rebates, and specifically, whether each household that used a rebate was part of the HER treatment group or the HER control group. Suppose that in the HER control group, 50 households used a CFL rebate, and in the

[15] The study population was restricted to single family, residential homes located in King County that use more than 80MBtu of energy per year, use both natural gas and electricity provided by PSE, do not use a solar PV system, have parcel data available from the county assessor, have a bill history that starts on or before Jan 1 2007, have 100 similarly sized homes within a two mile radius, and have automatic daily meter reads.

HER treatment group, 75 households used a CFL rebate. While the HER program is experimentally designed, so that it has both a treatment group that is exposed to the HER program and a control group that is not exposed to the HER program, the CFL rebate program in effect only has a treatment group: all households are exposed to the CFL program because anyone can receive the CFL rebates. So we can never observe the number of households that would have bought CFLs in the absence of the CFL program:

		HER Program	
		Control (not exposed to HER program)	**Treatment** (exposed to HER program)
CFL Program	**Treatment** (exposed to CFL rebate program)	50	75
	Control (not exposed to CFL rebate program)	?	?

As discussed in KEMA's Double Counting Memo, savings may be double counted by both the HER program and other programs only if the savings from measure installations are higher among households in the treatment group than those in the control group. In this example, 25 CFLs are double counted by both the HER program and the CFL program; the 50 CFL rebates that are used in both the control and treatment groups are only counted by the CFL program.

Because households were randomly assigned to the treatment and control groups for the HER program, as discussed above in section 2, any difference between the two groups can be attributed to the HER program (or to random noise, which can be addressed through statistical tests). Therefore, in this example, the HER program *caused* 25 extra people to participate in the CFL program by using a rebate: the HER program is a *necessary condition* for those 25 rebates.

The question then becomes: was the CFL program also a necessary condition for those 25 rebates? To answer this question, consider two extreme cases. In Case 1, The CFL program was not a necessary condition: the 25 extra households in the treatment group that used CFL rebates were motivated by the HERs to purchase a CFL, and would have bought them regardless of if there were a rebate or not (but since it was available, they used the rebate). In this case, if there were a control group that wasn't exposed to the CFL rebate program, we would see 25 more CFL rebates in the HER treatment group as compared to the HER control group:

***Case 1**: HER Necessary, CFL Not Necessary: 100% of double counted savings to HER.*		HER Program	
		Control (not exposed to HER program)	**Treatment** (exposed to HER program)
CFL Program	**Treatment** (exposed to CFL rebate program)	50	75 (25 more)
	Control (not exposed to CFL rebate program)	**20**	**45 (25 more)**

In this case, clearly 100% of the double counted savings should go to the HER program. At the other extreme, in Case 2, the CFL program was also a necessary condition: the 25 extra households that used CFLs wouldn't have bought any CFLs without the CFL rebate. In this case, if there were a control group that wasn't exposed to the CFL rebate program, we would see 0 more CFL rebates in the HER treatment group as compared to the HER control group. In this case, because both programs were necessary conditions to get the extra 25 CFL rebates, we might want to split the double counted savings with 50% for each program:

***Case 2**: HER Necessary, CFL Necessary: 50% of double counted savings to each.*		HER Program	
		Control (not exposed to HER program)	**Treatment** (exposed to HER program)
CFL Program	**Treatment** (exposed to CFL rebate program)	50	75 (25 more)
	Control (not exposed to CFL rebate program)	**20**	**20 (0 more)**

Because the CFL program doesn't have a control group, we can't tell which of these cases is correct. Without any additional information, we might choose an intermediate case, where the HER program receives 75% of the double counted savings and the tracked (CFL) program receives 25%.

Note that if the double counted savings are entirely given to the other, tracked program, this could create a perverse incentive for OPOWER to *not* direct customers to other programs.

Specific Implementation for the HER Program

LBNL Observation 22 *KEMA's Double Counting Memo provides a good analysis and estimates of the magnitude of the double counted savings for programs that were tracked. Specifically, see Table 3 and Table 4 below for double counting numbers (excerpted from KEMA's Double Counting Memo Tables 2-5). Table 3 uses a "Time of Participation" method, while Table 4 uses a "Load Shape-Allocated" method. LBNL* *agrees with KEMA that both methods are sound and that PSE should use whichever method it believes is appropriate from an accounting perspective.*[16]

LBNL Observation 23 *In meetings with PSE staff, they indicated that they were considering deducting the double counted savings from the HER program for ease of accounting purposes, but would not deduct these savings when considering the overall effectiveness of the HER program. LBNL agrees with PSE that for accounting purposes it may not matter which program receives the double counted savings. For considering the overall effectiveness of the HER program, LBNL recommends allocating the double counted savings such that the HER program receives between 50% and 100% and the other tracked program receives between 0% and 50% of the double counted savings, as discussed further below in section 6. Without any additional information, an intermediate case might be recommended, where the HER program receives 75% of the double counted savings and the tracked (CFL) program receives 25%.*

Table 3: Double Counted Savings for Tracked Programs, Time of Participation Method

		Year 1 (11/08-10/09)	Year 2 (11/09-10/10)	Both Years (11/08-10/10)
Electric	Test-Control (total double counted kWh)	93,711	5,736	99,447
	Double counted kWh per person in treatment (Divided by 27,094)	3.46	0.21	3.67
Gas	Test-Control (total double counted kWh)	34,703	45,810	80,512
	Double counted kWh per person in treatment (Divided by 27,094)	1.28	1.69	2.97

[16] The method used by KEMA can be done in either an aggregated form, as was presented in their Double Counting Memo, or can be done for each program separately; either method will result in the same estimate of double counted savings.

Table 4: Double Counted Savings for Tracked Programs, Load Shape-Allocated Method

		Year 1 (11/08-10/09)	Year 2 (11/09-10/10)	Both Years (11/08-10/10)
Electric	Test-Control (total double counted kWh)	25,580	76,605	102,185
	Double counted kWh per person in treatment (Divided by 27,094)	0.94	2.83	3.77
Gas	Test-Control (total double counted kWh)	8,424	45,345	53,768
	Double counted kWh per person in treatment (Divided by 27,094)	0.31	1.67	1.98

6.2 Other Programs That Are Not Tracked

General Discussion

While the example above used a CFL program as an example of a tracked program, in reality, CFL programs are usually targeted upstream and can't be tracked to a specific household. For programs that can't be tracked, in addition to the uncertainty about whether 50% or 100% of the double counted savings should go to the HER program, there is also uncertainty as to the actual magnitude of the double counted savings.

One method of estimating the magnitude of double counted savings due to non-tracked programs is to conduct surveys similar to those described in the Dougherty et al. 2011 paper "Moving Beyond Econometrics to Examine the Behavioral Changes Behind Impacts".

Specific Implementation for the HER Program

LBNL Observation 24 *LBNL recommends that PSE consider conducting survey research of customers to assess the possible impact of programs that are not tracked, such as upstream programs that cannot be traced to a specific household. For example, the analysis described in Dougherty et al. 2011[17] used surveys of individual households in order to determine the types of measures (e.g., appliances, CFLs, and weatherization) that households in a Massachusetts HER program installed.*

If the magnitude of the double counted savings cannot be estimated, then it is possible that this could cause a bias in estimates of savings; however, as described above, most of the double counted savings should be deducted from the other program. Therefore it is possible that the energy savings

[17] Doughterty, A., Dwelley, A., Henschel, R. and Hastings, R. *Moving Beyond Econometrics to Examine the Behavioral Changes behind Impacts.* IEPEC Conference Paper.

attributable to the CFL program are overestimated, and possible that energy savings attributable to the HER program are overestimated by a much smaller amount if at all.

7 Recommendations

Based on our analysis of the HER program, LBNL recommends the following going forward.

- In the future, LBNL recommends that a randomly allocated control and treatment group should be maintained in order to allow unbiased estimates of energy savings each year. In practice, this means that HERs cannot ever be mailed to *every* household. However, it is possible that the size of the control group could be reduced (50% of the study population is likely not needed). Analysis should be done to determine the smallest possible control group such that the estimates are likely to be statistically significant at 5%. If the control group size is reduced, then more people can be in the treatment group, and aggregate savings are likely to be higher[18].
- If the program is to be expanded to additional populations, LBNL recommends that a new study population is defined and a new control and treatment group randomly assigned from within the new study population. Again, an analysis should be done to determine the smallest possible control group so that as many households as possible can be in the treatment group.
- In future analysis, LBNL would recommend using either a difference-in-difference model defined in section 4.3.2 as Model 1 (which is the same as the method used to produce the "Difference-of-Differences" results in the last two columns of Table C-1 in KEMA's Evaluation), or a fixed effects regression with standard errors clustered at the household level that is not normalized for a "typical" year's weather, defined in section 4.3.2 as Model 2. Both models lead to unbiased estimates of energy savings with correctly calculated confidence intervals. Model 1 is a more simple analysis, while Model 2 may be slightly more precise in the sense that it may have slightly smaller confidence intervals.
- In the future LBNL recommends that KEMA or PSE continues to review program tracking databases to determine participation by customers in other PSE efficiency programs in order to calculate double counted savings for these tracked programs (using a method similar to that used in KEMA's Double Counting Memo).

[18] Two good references for determining the optimal control and treatment sample sizes are (1) section four in: Duflo, E., R. Glennerster, and M. Kremer. 2007. "Using randomization in development economics research: A toolkit." *Handbook of development economics* 4: 3895-3962. http://economics.mit.edu/files/806; and (2) section 4 Protocol 5 in: "Guidelines for Designing Effective Energy Information Feedback Pilots: Research Protocols*.*" EPRI, Palo Alto, CA: 2010. 1020855.

- LBNL recommends that PSE consider conducting survey research of customers to assess the possible impact of programs that are not tracked, such as upstream programs that cannot be traced to a specific household. For example, the analysis described in Dougherty et al. 2011[19] used surveys of individual households in order to determine the types of measures (e.g., appliances, CFLs, and weatherization) that households in a Massachusetts HER program installed.

[19] Doughterty, A., Dwelley, A., Henschel, R. and Hastings, R. *Moving Beyond Econometrics to Examine the Behavioral Changes behind Impacts.* IEPEC Conference Paper.

E. M&V report review details

Specifics of the research topics, methodology, and findings from the M&V documents examined as part of the Evaluation Planning and Application review (Section 3.3) are provided in Table 42 below.

Table 42: Summary of EM&V Studies

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
A	E214 - Single Family Existing	Fall 2007	Impact (gross)	Low Flow Shower-head Study	2008 Low Flow Showerhead Study.pdf	PSE	15-May-08	Outline energy savings and survey results for the direct mailing of showerheads to single family households	Survey mailed to 1,497 of 68,970 households that requested showerheads to determine installation rates and location of showerheads (primary or secondary showers)	survey mailed to 1,497 program participants, 373 returned, 330 completed
B	E217 - Multifamily Existing	2007-2009	Impact	MF Retrofit Impact Evaluation	PSE MF Wx Evaluation - Final Report.pdf	SBW	11-May-11	1. Determine program participant characteristics to determine energy consumption of existing multifamily buildings. 2. Establish baseline characteristics, excluding implemented program measures. 3. Estimate energy savings.	The evaluation team used typical energy program evaluation methods, including the review of data from utility program records, analysis of energy consumption histories, collection of characteristics data, analysis of load data collected from previous research, preparation of weather data, selection of representative participant buildings, prototype development and calibration to billing data, and prototype modeling of energy impacts from the program.	The information provided covered activity from October 2006 through April 2010, with 1,294 discrete entries over this period. Consolidating the program database, and then excluding the smallest savers accounting for less than 5% cumulatively of the savings for each fuel, yielded a sample frame of 149 sites where one or more measures were implemented. PSE and the evaluation team agreed to allocate the sample of 20 total sites to 12 electric savers (representing 106 sites) and 8 gas savers (representing 43 sites). The random sample occurred within seven domains, with each domain consisting of a combination of saved fuel and envelope measure class, such as Electric–Wall or Gas–Floor.

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
C	E249 - Pilots / Home Energy Reports	Fall 2008-Spring 2010	Impact	Home Energy Reports	2010HomeEnergyReports.pdf	KEMA	26-Oct-10	Evaluate effectiveness of program via review of energy consumption of participants in program (treatment group) compared to control group (non-participants). Also examined potential for double-counting energy savings due to participants enrolling in other PSE programs as a results of this program	Analysis for a 3 year billing period from July 2007 - June 2010 for both treatment and control groups, with program beginning half way through billing period, Nov 2008	Group of 83,811 households selected based on dual fuel, single family, >80 Mbtu/year, etc. Randomized selection of 39,755 households in group to participate in program with remainder acting as control group of non-participants
C'	E249 - Pilots / Home Energy Reports	2011	Impact	Home Energy Reports	PSE HER_Evaluation_Final.docx	KEMA	9-Mar-12	Continue the objectives enumerated under Study C, focusing on developing estimates free of savings credited to other PSE efficiency programs. Also quantify program savings for current treatment vs. suspended treatment groups	Analysis of daily billing data using a difference-of-differences approach to measure the difference in consumption between various groups, supplemented with household survey data.	Same group described for Study C, with 9,674 homes randomly assigned to stop receiving the Home Energy Reports (suspended treatment group).
D	E249 - Pilots / Prescriptive Duct Sealing and Repair Pilot Program	2010-2011	Impact and Process	Duct Sealing & Repair	2011 Duct Sealing & Repair Impact and Process Evaluation.pdf	Navigant	July 18, 2011	1. Quantify savings from duct sealing measures. 2. Make recommendations for program improvements.	Impact analysis consisted of a billing analysis of pre-post energy consumption of participating homes. Process evaluation included a review of the program database , in-depth interviews with 15 duct sealing contractors representing 80% of program activity,and surveys of program staff.	Billing analysis sample requirements included having an installation after Jan. 1, 2008 pf at ;east pme pf 7 measures. Control group was drawn from sample population, but not receiving the weatherization "treatment." Contractors interviewed represented 80% of program activity..

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
E	E250 - C&I Retrofit E257 - LED Traffic Signals E258 - Large Power User Self-Directed	2009-2010	Impact	C&I Impact Evaluation	PSE C&I Impact Evaluation Work Plan (Draft) 20110318. docx	Navigant	NA	Provide an accurate and insightful evaluation of program efforts and provide PSE staff with the feedback they need to increase program efficacy.	3 methods: Review of Stipulated Savings Estimates, Calibrated Engineering Models; hourly building energy simulation models and algorithm-based models, and Multivariate Regression Models.	Sample chosen based on population stratus, 42 electric sites, 37 gas sites. 90/10 confidence/margin of error for lighting measures, 80/20 for other electric, and 80/15 for gas technology.
F	E250 - C&I Retrofit E257 - LED Traffic Signals E258 - Large Power User Self-Directed	2009-2010	Process	C&I Custom Process Evaluation	PSE C&I Custom Program Process Eval Work Plan_draft final_2011_03_17.docx	Navigant	NA	• Are the programs being operated effectively and efficiently? • How can underserved customers be better reached? • How can underperforming programs be improved? • How can deeper savings best be obtained? • What levels of free-ridership and spillover are occurring?	Document review/Logic model development; PSE program staff interviews (12); tracking system review; PSE program benchmarking; trade ally interviews; PSE customer surveys	TBD
G	E250 - C&I Retrofit E257 - LED Traffic Signals E258 - Large Power User Self-Directed	2009-2010	Market	C&I Market	PSE CI Eval Work Plan_Market_ Final to PSE_2011-03-25.docx	Navigant	NA	» How is the market structured? » Which market segments are ripe for future programs? » How are the major trends shaping the market?	End user assessment: conduct phone surveys with participants and non-participants (?), in-depth interviews (8-10); Supply chain assessment: literature review, in-depth interviews with market actors (25)	TBD

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
H	E250 - C/I RetrofitE251 - C/I New ConstructionE 255 - Small Business Lighting	2005	Impact (gross, net)	Commercial Lighting Study	2007CommericalLightingStudy.pdf	RLW	20-Jul-07	Verify rebated lighting measure installations and calculate lighting time of use via telephone surveys and field measurement. Report evaluated savings.	Sample participant sites, collect reliable verification data, and analyze the data collected in order to generate energy and demand savings realization rates.	90/10 on savings and RRs at program level; Simple sampling technique on New Construction in which largest energy user (80%) plus four other large consumers (add'l 16%) were selected for detailed review. C&I Retrofit and Small Business had model-based statistical sampling and were stratified under optimal allocation by tracking estimate of annual energy consumption with double/nested sampling. C&I Retrofit had 30 sites sampled for on-site survey and 125 sites sampled for phone survey. Small Business had 35 on-site surveys and 125 phone surveys.

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
I	E253 - Resource Conservation Manager	Program inception in early 2000s through July 2008	Impact (gross, net)	Resource Conservati on Manager	2008 Resource Conservation Mgr Impact Evaluation. pdf	PSE	14-Nov-08	Quantify gross and net impact savings for program participants, i.e., those who hire and train a staff member to be a dedicated Resource Conservation Manager. Due the magnitude of the savings reported and the breadth of the program, the PSE evaluation team put a high priority on studying the realization rates for the RCM Program. In 2007, KEMA performed an evaluation on the RCM Program but due to proprietary agreements, was not able to perform a comprehensive impact evaluation and thus primarily focused on studying the RCM Program process. This evaluation attempts to address the open impact questions that were not studied in 2007. Specifically, this evaluation focuses on the energy savings realization across the participation sample.	Gross energy consumption recorded for baseline year, then compared to program participation years. Participants must have been enrolled in the program for at least one year as of 31 July 2008.	none provided

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
J	E253 - Resource Conservation Manager	Program inception in early 2000s through June 2007	Process	Resource Conserva-tion Manager	RCM_Evaluation Study_20071015.pdf	KEMA	15-Oct-07	• Assess barriers to establishing and maintaining an RCM position. • Characterize specific actions and activities undertaken by RCMs. • Assess barriers to RCM savings activities. • Verify energy saving measures and activities. • Estimate program impacts. • Evaluate the method used by PSE to allocate savings to different program elements.	Phone interviews with decision-makers at a majority of participating organizations, and some non-participating organizations. Detailed case studies at five participant sites.	For phone interviews, attempted a census of 49 program contacts and were able to survey 30. This was considered a representative group. Case studies were recruited to represent a range of organization types, program tenures, and part- vs. full-time RCM. Final panel was able to achieve this to some degree.
K	E262 - Commercial Rebate / Premium Service HVAC	2008-2009	Impact	Premium Service HVAC	2009 Premium Svc HVAC Impact Evaluation. pdf	PSE	4-Jan-09	Ensure the validity of the modeling	The impact evaluation design focused on collecting energy use through datalogging to compare against temperature data and a regression model was developed to extrapolate energy consumption across all temperature points. Bin temperature data was used to estimate annual energy consumption for pre and post-service and the savings was taken as the difference.	50 RTU's in 23 buildings, 10% heat pump, 90% gas pack, 0% electric resistance because few encountered in field for this measure. 3 categories in sample, office, retail, and specialty retail. 80% of units 7.5 tons or smaller. (only 23/50 loggers in 12 buildings provided consistent data to be analyzed). Sample frame included RTUs serviced in late 2008 and 2009.

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
L	E262 - Commercial Rebate / Premium Service HVAC	2008-2009	Process	Premium Service HVAC	2009 Premium Svc HVAC Process Evaluation. pdf	PSE	1-Jul-09	1. Compare elements of PHVACS program to other programs from other utilities, identify areas that may want to incorporate into PSE's PHVACS. 2. Understand contractor motivations for participating in program. 3. Understand customer motivations and barriers to program participation 4. Identify ways to increase contractor and/or customer participation in the program	In-depth interviews with 6 program managers and with 5 PSE PHVACS HVAC contractors.	none provided
M	E262 - Commercial Rebates / PC Power Management	2009-10	Impact	PC Power Manage-ment Evaluation	2011 PC Power Management Evaluation. pdf	Cadmus	4-Feb-11	Determine customer satisfaction with the program, evaluate effectiveness by comparing sample of computers with and w/o the PCPM software, and determine whether incentive should be offered for laptops with PCPM software installed.	Took spot measurements of computers in each mode: on, off, standby and compared usage between participant and non-participant computers. Then, metered computer kWh for 3 week and extrapolated to annual energy consumption for participant and non-participant sample and took the difference between them as annual energy savings.	22/22 participants and 16/19 non-participants had phone interview; on-site survey for a portion of participants and portion of non-laptop, non-PCPM software non-participants; cluster sample design to select participants and non-participants for metering based on # networked computers, computer usage, and operating hours.
N	E270 - Mainstreamin g Green (Project Porchlight)	2009	Impact		2009_2010Pr ojectPorch light.pdf	IRG	11/10/200 9 and 5/13/2010 (ERR 5/13/2010)	Assess whether Project Porchlight program is actually changing public attitudes and behavior towards conservation and other measures	Phone surveys pre- and post-campaign, included a control group; Install rates revisited via post 6 months survey	Respondents selected using random digit dial methodology, then classified as residing in either the treatment or control area

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
O	E270 - Market Research	2007	Impact	CFL Savings Adjust-ment & 2007 Market Study	2009 CFL Svgs Adjustmt & 2007 Market Study.pdf	EMI	6-May-09	Saturation study of Compact Fluorescent Lights by SCL, PSE and Snohomish PUD	none provided	none provided
P	E270 - Market Research	n/a	Market	CFL Savings Adjust-ment & 2007 Market Study	2009 CFL Svgs Adjustmt & 2007 Market Study.pdf	EMI	11/20/2007 (EER reported 5/6/2009)	1) To quantify standard (one-inch) screw-base sockets and the current placement of CFL bulbs, by room, fixture type, and control type; and 2) To quantify the saturation of CFL bulbs and assess consumer likelihood of installing additional CFL bulbs where they have not already done so. --remaining potential and future program design	Secondary Data review and mail surveys	59 reports reviewed; 6700 surveys mailed to achieve total sample size of 1200 (refer to Table 2-2)
Q	E270 - Market Research	-2009?	Market (penetration, cost)	VFD	2010VFD.pdf	Navigant/ Summit Blue	1-Mar-10	Gain a better understanding of the market for variable frequency drives (VFD) in retrofit applications in service territory. Provide the information needed to develop a plan to address the challenge of achieving deeper penetration into the market for retrofit applications of VFDs. Inform program design in the future with a focus on the market for retrofits in heating, ventilation, and air conditioning (HVAC) applications.	Marked assessment: in depth interviews and surveys to determine the market for VFDs in HVAC retrofit applications, using qualitative and quantitative analysis. Cost assessment: interviews, invoices and manufacturer data used to perform the cost assessment analysis.	Participant & non-participant (no VFD or VFD and no rebate) sample made. 13 participants, 6 customers recommended by PSE + 7 others drawn from rebate/grant applications based on # sites, facility size, completion date & facility type. 7 non-participants drawn from BOMA membership list and PSE contacts. 11 installation contractors, comprising 81% of the VFD rebates paid,

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
R	E270 - Program Evaluation	-2010?	Evaluation strategy (Process)	Evaluation Organiza-tion Study	2011 Evaluation Organization Study 4-4-2011.pdf	RIA	2/28/2011 (ERR 3/9/2011)	To assess and provide recommendations to inform decisions to strengthen existing evaluation function housed in Energy Efficiency Services (EES).	in-depth interviews with 12 internal stakeholders, 9 external stakeholders and review evaluation function at 6 other organization engaged in energy efficiency program administration	selection criteria not described for interviewees. External entities were selected in collaboration with PSE and WUTC staff

Table 42: Summary of EM&V Studies (Continued)

ID	Data Collection Methods	Data Analysis Methods	Recommendations	ERR Summary	Review Comments/Observations
A	mail in survey sent out 4 months after showerheads	none provided	Increase energy savings for showerheads, provided through the direct mail giveaway program, from 116 kWh to 136 kwh per year for each showerhead provided to an electric water heat customer. Increase energy savings for showerheads from 5 to 6 therms per year for each showerhead provided to a gas water heat customer.	Savings for showerheads, provided through the direct mail give away program, shall be increased to 136 kWh (6 therms) on January 1, 2009	
B	PSE project files, design documents, billing data	They developed two fully calibrated participant prototype models using eQUEST- one each for houses with electric or gas space heat. They also developed a baseline model for each prototype and each specific shell measure. Annual whole building energy savings for each prototype were computed as the difference between the as-built and combined shell measure baseline models. Non-shell measures provided negligible savings.	1. The program reduced electric use by 10% in electrically-heated buildings. 2. The program reduced gas use by 19% in natural-gas-heated buildings. 3. Deemed savings values for non-shell measures should be updated. 4. Program documentation should be improved. 5. Detailed, accurate building information is difficult to obtain.	Savings estimates in report were derived from a building prototype that is unlike any building in PSE service area. Savings estimates were very different from the RTF estimates. PSE will follow the directive of the RTF, not the directive of the report.	
C	Obtained billing history for treatment (participant) and control (non-participant) groups for 3 year period, household characteristic data, and frequency of report delivery for program participant group.	Difference-of-difference and pooled model billing analysis. Compared energy/therms l usage for participant sites for pre and post program implementation periods.	Ongoing evaluation	Agreed to ongoing annual evaluation. Discontinued sending energy reports to 1/3 of participants to study persistence effect of program. Not claiming savings for 2010.	Compared these results with PG&E 2006-08 HEES study, done by EcoNW. Showed similar gross savings, but applied NTGR of 20% to estimate directly attributable net savings. PG&E study much more in-depth, since they interviewed customers. Perhaps Task 4 study would be to do an exhaustive literature search and comparison of PSE HERS with other programs around the country.
C'	Same as for Study C	Same as for Study C, but also examined quarterly and monthly suspended and non-suspended groups.	Statistically significant savings for all three programyears, even with the suspended group. Average household savings ranged from 170 kWh in Year 1 to 274 kWh in Year 3 for residences with continued reports.	NA	A WUTC-commissioned study by Lawrence Berkeley National Labs (LBNL Analysis of PSEs Pilot Energy Conservation Project 2011 10 17.pdf) concluded that the KEMA analytical approach was excellent and that the energy savings were valid. The report cautioned the results only applied to

ID	Data Collection Methods	Data Analysis Methods	Recommendations	ERR Summary	Review Comments/Observations
					the localized study population over the study period.
D	review of program data and field measurement and verification	Use loggers to estimate the population mean savings per square foot of conditions space and use billing analysis to develop more detailed regression-based models of how observable characteristics condition savings.	TBD	N/A	Note that research design yields net savings, but PSE reports gross savings only.
E	spot measurements, metered data, billing data	Review of prescriptive input assumptions used in similar programs, secondary literature and evaluations, and a comparison of input assumptions to field collected variables; hourly building energy simulation models and algorithm-based models; regression analysis of large sets of consumption data such as billing records and end-use metering data sets.	Ongoing evaluation	n/a	
F	in-depth interviews; trade ally surveys; participant, partial participant, and non-participant surveys	Review of PSE's documentation and marketing material, the participant database analysis, PSE staff interviews, customer surveys, trade ally in-depth interviews, and the benchmarking of PSE's programs	TBD	N/A	
G	analyze secondary data; phone surveys and in-depth interviews	Review qualitative and quantitative results of surveys and interviews, analyze secondary data. Will identify themes and characteristics that define market segments with high potential to respond to PSE intervention.	To be addressed: » Target market segments with the potential to create significant energy efficiency savings; » Key relationships with market actors that can enhance program performance; » Input on framing and selecting the suite of measures for which incentives are provided.	N/A	
H	File reviews; phone surveys; program-specific on-site instruments for consistent data collection; monitoring with spot-watt readings, time-of-use lighting loggers and true RMS power loggers.	Gross: calculating energy savings through facility operational hours, lighting fixture counts, and lighting wattages based on phone and on-site survey dataNet: develop NTGR from free-ridership which was estimated with customer self-reporting.	1. Compare projects' energy consumption to Washington State Energy Code or other baseline energy consumption benchmark. 10. This report determined the C&I program trend was an over-estimate of hours of use. 12. For the CNC program, separate savings by LPD reduction and controls savings.	Small Business: no changesNew Construction: -established prescriptive savings estimates via whole building energy modeling for three major building types (schools, offices, retail) based in industry standard operation hours.- for custom projects,	In Sample Design, concluded that should be error ratios higher for SB than C&I Retrofit, but used the same error ratios as latter w/out explanation of why lower ratios were applied. In Data Collection, state that files of 6 New Construction sites were reviewed even though the sample size for that program was only 5.

ID	Data Collection Methods	Data Analysis Methods	Recommendations	ERR Summary	Review Comments/Observations
			13. Have a process of checking that all applicable savings are applied to the appropriate site and are reasonable. 14. CNC sites are the most difficult to estimate hours of operation in the planning phase. To improve the accuracy of a sample of projects, especially those associated with a large kWh reduction, use time-of-use meter results from existing similar facilities. 15. The controls fraction was aggressive for an occupancy based system in the largest CNC facility.	reduced operation hours from industry standard need will need to be justified and may be subjected to additional validation post installation.-implemented verification plan which allows for revisions to savings estimates and grant amounts if installed measure different from design.C&I Retrofit:- increased documentation of method- increased datalogging-improved process such that lighting hours rationale is part of GIF and verified by QC reviewers.	
I	1. obtain project file 2. obtain customer start date & years of participation 3. identify facilities associated with RCM program 4. Query database for annual energy usage, specifically natural gas and electricity obtained from PSE for participating facilities 5. query database for square footage for participating facility 6. query database for monthly heating days for territories with participating facilities.	Gross: Regression analysis on energy consumption corrected for heating degree days and square footage. Net: Difference between gross and energy saved from installation/implementation of "hard" measures based on PSE programs.	Compute customer net energy use on an annual basis and enter energy savings values into CSY using PSE-calculated net energy usage results. Provide grant money upon validation of annual energy savings, provide additional training to RCM personnel who under perform against RCM customer agreement, enforce RCM customer agreement more strictly, align incentives more closely with energy savings performance. Require higher level RCM staffing for business/government customers, tailor RCM customer agreement to include some punitive disincentive for failure for corporate/government customers, focus grant money and staff on school districts.	[While this study predated ERR process, this impact study coupled with the previous process study led to program revision and improvements.] Regarding inconsistencies in CSY savings and customer performance, they will perform true-ups on an annual basis for each customer and document process and develop a QC process for grant requests and savings claims. For RCM's not adequately tracking building changes to allow adjustments on savings calculations, they will provide specific guidelines for tracking information, develop tools for inventorying building changes, decommissioning, load additions, remodels and occupancy, and enforce annual true up in scope of work. For customers not	See 2007 RCM process study.

ID	Data Collection Methods	Data Analysis Methods	Recommendations	ERR Summary	Review Comments/Observations
				hitting their target energy savings, they will add incentives to years 2 and 3 for customers, review scope of work for non-performing RCM's and re-assess interest in program, mandate training for non-performing RCM staff and consider including consequences of not performing.	
J	In-depth telephone interviews with decision-makers at both participating and nonparticipating organizations. Detailed case studies of select participants, including further in-depth interviews with the RCMs themselves and high-level audits at specific facilities.	Billing analysis with adjustments for heating and cooling degree days for the 5 case study organizations. Ex post savings results highly qualified and fairly inconclusive, because of many exogenous factors that also affect energy use.	1. Program requirements: (a) improve customer materials to better explain program, (b) help RCMs find more time for their roles, (c) improve tracking of RCM activities. 2. Process: (a) improve RCM support services, (b) improve consistency and documentation of ex ante savings, (c) reexamine savings allocation approach, (d) standardize policy on site-based incentives. 3. Trainings and Services: (a) expand training offerings, networking opportunities, and engineering support. 4. RCM toolbox: (a) provide energy audit tools and spreadsheet/document templates. (b) identify successful programs and help replicate at other organizations. 5. Other data issues: (a) improve abilities to obtain billing data from non-PSE utilities.	None provided.	See 2008 RCM impact study.
K	Billing records, metering equipment.	initially billing analysis considered, but effects too small compared to overall usage and no way to account for changes in occupancy. Dataloggers installed on 50 RTU's for 10 months - 2 months pre-protocol and 8 months post. Logged data analyzed against temperature index for pre and post protocol implementation to determine usage as a function of temperature, then using temperature bin data for Puget Sound, energy usage calculated for pre and post condition and subtracted	No conclusive results because sample size too small to represent population, however, new 2009 modeling has potential barring more testing, thermostat scheduling measure contribute to energy savings and should be emphasized, sensor replacement measure are being applied incorrectly or they result in little or no actual energy savings, more work should be done to understand most cost effective/energy saving measures.	original savings model overestimates savings, increase efforts to understand RTU behavior based on measurements, develop new model based on regional studies to better understand savings based on building type and specific protocol elements.	

ID	Data Collection Methods	Data Analysis Methods	Recommendations	ERR Summary	Review Comments/Observations
		to determine savings.			
L	In-depth interviews	Qualitative descriptions for three areas: Technical/economic, Market, Organizational	1. Increase engagements with the contractor network to strengthen relationship (workshops, specialty training, discuss contractor expectations for tech support in field). 2. Improve data management (have contractors input records into web-based interface, improve automation of reporting).	1. Increased number of tech staff at NEEC (completed). 2. Offer workshops through NEEC (planned by July 1st). 3. Explore options for web based data management (will explore at same time as other CMS work underway). 4. Increase marketing of program through various channels (create marketing plan by May 1, 2010).	
M	phone interviews, follow up surveys, and equipment metering	metered computer kWh for 3 week and extrapolated to annual energy consumption for participant and non-participant sample and took the difference between them as annual energy savings.	Use more aggressive settings to force not in use computers into "sleep" mode during evenings and weekend, implement software on all computers, additional information for participants, target buildings with "standard" operating hours and few evening/weekend usage, offer incentives for installing free online solutions	Going to adjust RTF deemed savings to 117 kWh, continue to disallow laptop rebates, have customer provide monitoring report 30 days in before receive rebate, send out educational letter to participants to encourage maximum energy savings.	
N	Phone surveys	Statistical significance in changes between the pre- and post-campaign surveys using a paired-samples t-test.	Revised savings estimate of 29.3 kWh confirms that the original estimate of 14.85 kWh per bulb was conservative	One-time program, so no implementation action will be taken. Will not be reporting incremental savings over the first evaluation. Measure Metrics documentation will need to be revised to reflect the most up-to-date information.	
O	none provided	none provided	Change Retail Rebate CFL savings to 24 kWh and change the measure life for all CFL bulbs to 5 years	Effective January 1, 2010 energy savings for Retail Rebate CFL bulbs will change to 24 kWh, and the measure life for Retail Rebate, Direct Install and Give Away CFL bulbs will change to 5 years	
P	Mail in surveys, non-respondent phone interviews	Review of secondary data to guide data collection; qualitative and quantitative analysis of surveys to determine saturation and remaining potential	1. Encourage installation of additional CFL bulbs throughout the house. 2. Continue to facilitate consumer purchases through utility CFL rebate and coupon programs. 3. Develop a strategy that	1. Retail Rebate CFL savings drop from 33kWh to 24 kWh. 2. Direct Install CFL Savings will remain at 33 kWh. 3. Measure life will drop from 9 years to 5	2009 CFL Savings Adjustment Whitepaper not included

ID	Data Collection Methods	Data Analysis Methods	Recommendations	ERR Summary	Review Comments/Observations
			focuses on encouraging individuals in the multifamily sector to try CFL bulbs for the first time. 4. Promote the use of CFL bulbs in low saturation rooms. 5. Promote and provide information on all specialty bulbs currently available and continue efforts to promote development of specialty bulbs not yet available in the market.	years for Retail Rebate and Direct Install CFL Bulbs.	
Q	phone interviews with participants, non-participants, and supply side contractors; in depth survey of more existing and potential participants;	2 assessments: market & cost. For market assessments, straightforward calculations of such sample statistics as response distributions (histograms), sample correlations, and sample means, with standard errors and confidence intervals calculated where feasible and warranted. For cost assessments, weighted averages, regression models and custom cost estimates.	Look for all VFD opportunities at HVAC retrofits, market program better so everyone knows about the opportunities and everyone who installs a VFD applies for the incentive through PSE, adjust incentive scale to make smaller scale projects more affordable/desirable, provide more information about energy savings and other benefits from VFD's, inform decision makers of financial & non-energy savings benefits, create database with all program's participant customer information to be used as potential participants in other programs, maintain up to date product cost information.	Current program favors larger VFD installations, cost effectiveness study should be conducted to determine if higher incentive for small scale installations would pass the cost effectiveness test	
R	in-depth interviews and document review	Qualitative description of interviews; comparison of program spending and evaluation budges, evaluation factors	Identified 6 areas of consideration: 1. How evaluation spending is prioritized. a. consider augmenting existing priorization process to include program-level activities and emerging or custom measures. b. consider the skills required to effectively evaluate C&I custom project programs and ensure that these skills are available. 2. the level of evaluation expenditures. a. engage in planning for evaluation in a different way. 3. the precision, scope and focus of evaluation work. a. develop a more formal evaluation strategy and evaluation plans for the residential and the	Action items: 1a. Develop evaluation plans at program level may develop some plans at sub-program level. 1b1. Technical expertise to be made available through consultant or other 3rd party. 1b2. strengthen in-house evaluation skills. 2a emphasize more holistic evaluation planning at program level. 2b. identified factors to base scope of evaluation. 2c identified criteria for determining frequency of	

ID	Data Collection Methods	Data Analysis Methods	Recommendations	ERR Summary	Review Comments/Observations
			nonresidential sectors. b. clarify and strengthen the existing process for evaluation initiation. c. build understanding about what evaluation can do, the merits and limitations of different types of evaluations, and what to expect from evaluation products. 4. the organizational fit for evaluation team members. a. consider changing the reporting pathway for evaluation. b. may need an evaluation professional to lead the evaluation group. 5. the integration of evaluation activities and products into program management. a. continue to use the ERR and consider opportunities for providing results rapidly. b. develop a document like the ERR that describes the process for initiating and implementing evaluation. 6. integrating evaluation results into rates and regulatory incentives. a. establish how results will be measured and who will do it.	evaluation. 2d. planning to be led by program evaluation team, with collaboration from others. 3a. develop formal evaluation framework and protocols. 3b. prepare formal evaluation plans. 3c. define roles and responsibilities for program staff and evaluation staff. 3d. document expectations to show where integration expected. 3e. develop process for initiating and implementing evaluations. 3f develop and present evaluation information package for stakeholders. 3g. consider using a development expert to facilitate new processes and content. 4a. evaluation team continues to report to Dir. of Customer Energy Mgmt. 4b. hire a new employee to lead the evaluation team. 5a. ERR process will be a standard practice. 5b promote more rapid collection and distribution of evaluation results. 5c develop a process like ERR for initiating and implementing evaluation. 6a Monitor this issue and consider evaluation requirements as discussion on these topics occur.	

F. On-site verification materials

Key materials used during the targeted on-site verification effort (described in Section 2.3) are provided here. These include examples of the introductory letters sent to each business, single-family residential, and multi-family residential customer who was sampled. Also included is the letter sent to single-family residential customers who participated in the refrigeration decommissioning program, as well as the corresponding phone survey guide. That program's verification process was somewhat different because it only involved a telephone survey.

The last item is an example of the on-site form that surveyors used to guide their inquiries and data collection. One was generated for each sampled project.

Introductory Letters to Customers

Business

PUGET SOUND ENERGY
The Energy To Do Great Things

Puget Sound Energy
P.O. Box 97034
Bellevue, WA 98009-9734
PSE.com

Dear Customer:

Puget Sound Energy (PSE), the Washington Utilities and Transportation Commission (WUTC), and other stakeholders are engaged in a study that provides an independent third party review of electric savings from PSE's 2010-11 energy efficiency programs. The study will help PSE improve their programs and better serve their customers.

SBW Consulting, Inc. (SBW), of Bellevue, Washington, has been retained to conduct the review. As part of their efforts, they are inspecting a small number of energy efficiency projects, which were completed during the two-year period. Your business location at «Project Name», «Site Address» in «Site City» has been randomly selected to be one of the PSE 2010-11 program participants to be part of this study.

PSE would greatly appreciate your support in this effort by agreeing to participate in this study. We expect that these inspections will be brief and have minimal impact on your operations. They will consist of a visual examination of the efficiency measure(s), and a few questions for an individual at the facility knowledgeable about the project. In the near future, you will receive a call from SBW to set up an appointment for the inspection. All information collected as part of this effort will be kept confidential.

Thank you very much for allowing us to complete this important work, as it will serve to further assist PSE in delivering energy efficiency programs that help commercial and industrial customers use energy wisely. Should you have any questions or concerns, please contact either the SBW study manager, Bing Tso, PE (425-827-0330) or the PSE project manager, Bill Hopkins (425-462-3391).

David Landers

David Landers, PE, CEM

Manager, Business Energy Management
Puget Sound Energy

Single-family Residential

PUGET SOUND ENERGY
The Energy To Do Great Things

Puget Sound Energy
P.O. Box 97034
Bellevue, WA 98009-9734
PSE.com

Dear Customer:

Puget Sound Energy (PSE), the Washington Utilities and Transportation Commission (WUTC), and other stakeholders are engaged in a study that provides an independent third party review of electric savings from PSE's 2010-11 energy efficiency programs. This study will help PSE improve their programs and better serve their customers.

SBW Consulting, Inc. (SBW), of Bellevue, Washington, has been retained to conduct the review. As part of their efforts, they are inspecting a small number of energy efficiency projects, which were completed during the two-year period. Your home at «Customer Address» in «Customer City» has been randomly selected as one of the PSE 2010-11 program participants to be part of this study.

PSE would greatly appreciate your support in this effort by agreeing to participate in this study. We expect that these inspections will be brief. They will consist of a visual examination of the efficiency measure(s), and asking you a few questions about the project. All information collected as part of this effort will be kept confidential.

In the near future, you will receive a call from SBW to set up an appointment for the inspection. If you agree to participate, they will give you a $20 Visa® gift card, redeemable anywhere Visa® is accepted, upon completion as a token of our appreciation for your assistance.

Thank you very much for allowing us to complete this important work, as it will serve to further assist PSE in delivering energy efficiency programs that help residential customers use energy wisely. Should you have any questions or concerns, please contact either the SBW study manager, Bing Tso (425-827-0330) or the PSE project manager, Bill Hopkins (425-462-3391).

Jeff Tripp

Manager, Residential Energy Management
Puget Sound Energy

Multi-family Residential

PUGET SOUND ENERGY
The Energy To Do Great Things

Puget Sound Energy
P.O. Box 97034
Bellevue, WA 98009-9734
PSE.com

Dear Customer:

Puget Sound Energy (PSE), the Washington Utilities and Transportation Commission (WUTC), and other stakeholders are engaged in a study that provides an independent third party review of electric savings from PSE's 2010-11 energy efficiency programs. This study will help PSE improve their programs and better serve their customers.

SBW Consulting, Inc. (SBW), of Bellevue, Washington, has been retained to conduct the review. As part of their efforts, they are inspecting a small number of energy efficiency projects, which were completed during the two-year period. Your property at «Customer Name» in «Customer City» has been randomly selected as one of the PSE 2010-11 program participants to be part of this study.

PSE would greatly appreciate your support in this effort by agreeing to participate in this study. We expect that these inspections will be brief. They will consist of a visual examination of the efficiency measure(s), and asking you a few questions about the project. All information collected as part of this effort will be kept confidential.

In the near future, you will receive a call from SBW to set up an appointment for the inspection. If you agree to participate, they will give you a $20 Visa® gift card, redeemable anywhere Visa® is accepted, upon completion as a token of our appreciation for your assistance.

Thank you very much for allowing us to complete this important work, as it will serve to further assist PSE in delivering energy efficiency programs that help residential customers use energy wisely. Should you have any questions or concerns, please contact either the SBW study manager, Bing Tso (425-827-0330) or the PSE project manager, Bill Hopkins (425-462-3391).

Jeff Tripp

Manager, Residential Energy Management
Puget Sound Energy

Refrigerator Decommissioning

PUGET SOUND ENERGY
The Energy To Do Great Things

Puget Sound Energy
P.O. Box 97034
Bellevue, WA 98009-9734
PSE.com

Dear Customer:

Puget Sound Energy (PSE), the Washington Utilities and Transportation Commission (WUTC), and other stakeholders are engaged in a study that provides an independent third party review of electric savings from PSE's 2010-11 energy efficiency programs. This study will help PSE improve their programs and better serve their customers.

SBW Consulting, Inc. (SBW), of Bellevue, Washington, has been retained to conduct the review. As part of their efforts, they are investigating a small number of **refrigerator decommissioning projects** completed during the two-year period. Your home at Customer Address in Customer City has been randomly selected to be part of this study.

PSE would greatly appreciate your support in this effort. Doing so is easy: simply call the review team's telephone surveyor at 425-827-0330 Ext: 237 between the hours of 10 A.M. and 6 P.M., Monday through Friday, preferably before February 17. Otherwise, if we don't hear from you, we will try calling you directly. The survey consists of a few simple questions about the project. All information collected as part of this effort will be kept confidential. As a bonus, **if you complete the phone survey, we will give you a $20 Visa® gift card** redeemable anywhere Visa® is accepted, as a token of our appreciation.

Thank you very much for allowing us to complete this important work, as it will serve to further assist PSE in delivering energy efficiency programs that help residential customers use energy wisely. Should you have any questions or concerns, please contact either the SBW study manager, Bing Tso (425-827-0330) or the PSE project manager, Bill Hopkins (425-462-3391).

Jeff Tripp
Manager, Residential Energy Management
Puget Sound Energy

Procedures for Refrigerator Decommissioning Telephone Survey

Verification steps

1. **Collect data from program files.**
   XXX has entered relevant information from the program implementer files, in \\FS1\Postoff\Projects\PSE17 (3rd Party Review)\Detailed Reviews\4E - On-site Verif\On-site Sample Selection.xlsx ("Fridge DCx Matrix" sheet).
2. **Develop procedures**
   Need to figure out number to call, and times when it is OK to do so. Make sure YYY is clear on the script.
3. **Draft Letter approved**
   Draft in conjunction with YYY and send to Jeff Tripp for approval. Emphasize gift card.
4. **Mail letters**
   Mail merge ~30 letters and send out. Be ready for calls the next day from eager first responders.
5. **Field / make calls**
   Wait a few days, and hopefully calls will come in. Afterwards, begin calling those we have not heard from. Administer survey. The general objective for each site is to determine if the program records jibe with the occupant's descriptions of what was in place before.
6. **Compile data**
   Enter information in "Fridge DCx Matrix" sheet.
7. **Mail out gift cards**
   For customers marked in "Fridge DCx Matrix" sheet as Completed, have XXX send out gift card letter.

Survey questions

A. Confirm name and address, correct if wrong (check list, sorted by city, street).

B. Explain purpose of survey (should match letter)

C. "Our records show that you participated in this program"

D. Do you recall? If no, is there anyone else there who might recall?

E. If yes, open-ended prompt: how did you like the program?

F. How many units did the program remove? Could you describe them with as much specificity as you can (prompt if necessary about age, where in house, brand, color, but don't give them the "answers" from our database!)? (compare what they say with what our database says in regards to # units, whether fridge or freezer, location, brand, color, age, date removed)

G. Do you recall roughly when the program removed them?

H. Have you purchased any other fridges or freezers since that time? (if so, ask for elaboration)

That concludes the survey. Thank you for your time. We will be sending you a $20 gift card as a token of our appreciation.

On-site Form

2010-11 PSE Third-party Review: Detailed Review – On-site Verification

Date Verified: ______________________
Verifier: xxxxx
Site Info:

Project ID – 22511 xxxxxxx DR E, xxxxx, 98xxx
Address – 22511 xxxxxxx DR E
Contact Name and Phone Number – xxxxxxx, 555-555-5555
Program/Domain/Element – Single Family Existing Exclude Weatherization/Homeprint/Water Heat
Participation Year – 2010
Measures – Water Heater Electric

1. Individual(s) interviewed

2. Verification activities, e.g., inventoried sample of fixtures, checked nameplate, observed settings, interview manager

3. Were measures associated with the sampled project implemented as described in project documentation[71]?

- If not, did the program err, or was it because of a factor out of PSE's control?

- If measures installed different than described, describe what was installed:

4. Is the project eligible (e.g., PSE electric customer[72], measure(s) appropriate to program[73])?

[71] If there is a discrepancy and no one on-site can explain, then answer is "unknown."

[72] Verify only if customer near PSE Electric Service Territory border; check meter or electric bill.

[73] Verify only if installed measures different from project documentation

G. Minor discrepancies from on-site reviews

The table below lists the 25 minor discrepancies uncovered during the targeted on-site reviews. Ten of these occurred at residential sites; the remaining 15 were business sites. In all cases, the review team concluded that these discrepancies were minor, and either individually or in aggregate did not materially affect the overall portfolio savings claim. Nonetheless, this list was sent to PSE for their review, so they could adjust their reported savings as appropriate.

Table 43: On-site review discrepancies

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
REM	Heat Pump Tier 2	2010	E214	Single Family Existing Exclude Weatherization /Space Heat	A	Des Moines	2/2/2012	Checked nameplate.	Yes		Customer complained that his furnace was damaged by a power surge in the recent storm and he had to pay $1300 to have the circuit board and fan motor replaced. York refused to cover it under warranty due to the power surge.	Yes
REM	MH Arra-UCONS Duct Sealing L1	2011	E214	Single Family Existing Weatherization	B	Ferndale	1/31/2012	Verified that duct sealing had be done at the home.	Yes, but duct sealing is spotty.		The duct sealing installation was done sparsely and probably is not performing well.	Yes
REM	Floor Insulation R-0 to R-30 - FAF	2010	E214	Single Family Existing Weatherization	C	Black Diamond	2/22/2012	Inspected floor insulation, duct insulation, and duct sealing.	Yes, but duct sealing is spotty.		Yes, but very thin application of mastic for duct sealing.	Yes

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
REM	attic (r11-r38) Windows Single to Double (1.2 to.30	2010	E217	Multi Family Existing	D	Kent	2/2/2012	Counted window square footage; Inspected attic through an access hole in the only available apartment.	Yes/No	(2) factors out of PSE's control	I found all insulated windows to be installed. From the one available attic access hole I could see no blown insulation, just two courses of R-11 batts that probably were there before. The landlord will take this up with the contractor.	Yes
REM	CFL In unit pipewrap showerhead	2010	E217	Multi Family Existing	E	Redmond	1/30/2012	Inventoried sample.	CFLs yes; pipewrap some; showerheads none.	(1) program issues	The pipe wrap was not favored by the development staff because it disguises pipe leaks, so the residents don't notice leaks. Thus, the staff remove the wrap whenever they have to work on the pipes, and they don't replace it. Showerheads are universally disliked by residents due to flow being too low. I found none of them still in place. Staff complained about the quality of the work as well as the quality of the products.	Yes

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
REM	CFL In unit pipewrap showerhead	2010	E217	Multi Family Existing	F	Kent	3/7/2012	Looked at showerheads, pipe wrap, and CFLs.	Mostly, one unit did not have low flow showerhead or CFLs.		One unit did not have CFLs and low flow showerhead.	Yes
REM	Common Area Lighting	2010	E217	Multi Family Existing	G	Bellevue	2/8/2012	Inspected lighting.	Not all	(2) factors out of PSE's control	Everything was found except that only 58 of the 65 office lamps were found.	Yes
REM	Energy Star hard-wired CFL Fixture - TCt 61, Energy Star Refrigerator, Showerhead - Max 2.0 gpm EWH 2010-2011, Windows U-0.30 or better ESH	2010	E218	Multi Family New Construction	H	Auburn	3/7/2012	Looked at lighting, windows, refrigerators, and showerheads.	Mostly except none of the showerheads checked were low flow models.		No low flow showerheads seen. May have been replaced by renters.	Yes
REM	Attic Insulation R-11 to R-38 - FAF	2010	E214	Single Family Existing Weatherization	I	Port Orchard	2/20/2012	Inspected attic insulation, duct insulation, and duct sealing.	Yes, but duct sealing is spotty.		Attic insulation and duct insulation were good. Duct sealing not great. Checked sealing at 3 seams. 1 spot was complete, 1 spot was partially done, and 1 spot was completely missed.	Yes

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
REM	MH Arra- CFL (DI Exterior) MH Arra- CFL (DI Interior) MH Arra- Pipewrap MH Arra- Showerheads (Leave Behind) MH Arra- UCONS Duct Sealing L1	2010	E214	Single Family Existing Weatherization	J	Sumner	2/22/2012	Inspected/counted CFLs, showerhead, pipe wrap, and duct sealing.	Yes, but duct sealing is spotty.		Examination of duct sealing at floor registers showed evidence of work, but little to no mastic to seal gap between duct edges and floor.	Yes
BEM	$50 lamp for lamp F32T8 lamps LBF	2010	E255	C/I Lighting	829116	Bellingham	2/7/2012	Completed a full inventory of all measure lighting and inspected one random ballast also checked hours of operation.	No		Fixture type and quantity is correct but only about 75% of the fixtures have been retrofitted to T8s. The contractor fired/walked off of job and took materials with him.	Yes
BEM	$225 new 6 lamp F32T8 fixture EB $40 Occupancy Sensor or Timer C 100 to 199W $50 lamp for lamp F32T8 lamps LBF	2010	E255	C/I Lighting	825027	Renton	1/5/2012	Completed a full inventory of all measure lighting and ceiling height prevented ballast observation also checked hours of operation.	No		Quantity is 17 not 19 for measure described as HID to 6 lamp T8.	Yes

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
BEM	$190 New 6 lamp F32T8 fixture EB	2010	E255	C/I Lighting	830913	Sumner	1/31//2012	Looked at and counted fixtures and lamps per fixture. And talked to manager about how the fixture count and type varied from the rebate form. She said they paid extra at the time of the changeout to get more fixtures.	No. Instead of there being nine 6-lamp F32T8 fixtures as per the rebate form there were sixteen 4 lamp fixtures.		Instead of there being nine 6-lamp F32T8 fixtures as per the rebate form, there were sixteen 4-lamp fixtures.	Yes
BEM	$130 new CFL fixture >80 input watts $50 lamp for lamp F32T8 lamps LBF $6 screw-in CFL, 26-40W E Star $70 Kit four F32T8 lamps 1 EB $70 Kit lamps reduced to 2 or 3 F32T8 LBF $90 kit four F32T8 lamps EB	2010	E255	C/I Lighting	821105	Bremerton	1/26/2012	Looked and counted fixtures and opened a few.	No	I could not find compact fluorescent fixtures	Could not find the 12 compact fluorescent fixtures claimed on the rebate sheet and invoice. But the T8 fluorecent fixtures measures were all verified.	Yes

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
BEM	$85 2 F32T8 lamps, 1 EB	2010	E255	C/I Lighting	839644	Kirkland	1/23/2012	Inventoried fixtures.	No	(1) Program documentation error?	The two 8' lamps in each fixture were replaced with four 4' lamps, not two as described in the paperwork. This looks like a paperwork error.	Yes
BEM	$85 2 F32T8 lamps, 1 EB	2010	E255	C/I Lighting	837698	Renton	12/21/2011	Completed a full inventory of all measure lighting and inspected one random ballast. Also checked hours of operation.	No		Measure described as 8' 2 lamp T12 retrofitted to 4’ 2 lamp T8 is incorrect the correct description is 8' 2 lamp T12 retrofitted to 4' 4 lamp T8. Quantity is 11 not 12 for the measure.	Yes
BEM	$60 reduce lamps to 2 F32T8 lamps EB	2010	E255	C/I Lighting	841512	Redmond	1/30/2012	Inventoried fixtures.	No	(2) factors out of PSE's control	Nothing was installed, and also, there are 11 fixtures, not 12. Building engineer will follow up with contractor. The work seems to have been done in other units, though not very well.	Yes

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
BEM	$60 reduce lamps to 2 F32T8 lamps EB $70 new lamps reduced to 2 or 3 F32T8 LBF	2010	E255	C/I Lighting	810029	Anacortes	3/1/2012	Verified the installed lighting fixture types and quantities matched the fixture types and quantities listed in the project file.	No		The project included 2 measures. 1st measure was to be the retrofit of 11 4 ft. 4 lamp T12 fixtures to 11 4 ft. 2 lamp T8 fixtures. The 11 4 ft. 4 lamp fixtures were retrofitted to 4 ft. 4 lamp T8 fixtures, but no lamp reduction was done. The 9 fixtures mentioned in the 2nd measure were not found. It did look like a 2nd measure had been done but it was a retrofit of 2 8 ft. 2 lamp T12 fixtures to 2 4ft 4 lamp fixtures.	Yes
BEM	$55 lamp for lamp F32T8 LBF $6 screw-in CFL, 26-40W E Star $90 kit four F32T8 lamps EB	2010	E255	C/I Lighting	815520	Tukwila	1/17/2012	Inventoried fixtures.	No	(2) factors out of PSE's control	Not all fixtures were found. There has been a tenant change and the space was split in two, so some fixtures may have been removed.	Yes

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
BEM	$130 new CFL fixture >80 input watts $3 screw-in CFL, >26 watts, E Star $50 Kit 1 or 2 F32T8 LBF reqd $50 new LED exit sign (not kit) ES $70 Kit lamps reduced to 2 or 3 F32T8 LBF	2010	E255	C/I Lighting	821158	Redmond	12/21/2011	Confirmed lamp type and counted fixtures.	No	unknown	65-F32T8 fixtures still have 4 lamps, they were not reduced to 3 lamps as indicated in the documentation. The site contact said they were told they could reduce the number of lamps, but they opted to keep all 4 in the interested of keeping the room brightly lit.	Yes
BEM	$40 lamp for lamp F32T8 lamp(s) LB factor reqd $40 Occupancy Sensor, controlling 100 to 199W $70 Lamps reduced to 2 or 3 F32T8 LB factor	2010	E255	C/I Lighting	837951	Redmond	12/19/2011	Tested occupancy sensor and interviewed tenant.	No	yes and no	Tenant did not know what the device (occupancy sensor) was, so she never called anyone to fix it since she didn't realize it was broken.	Yes

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
BEM	$130 new CFL fixture >80 input watts $225 new 6 lamp F32T8 fixture EB $50 lamp for lamp F32T8 lamps LBF $60 reduce lamps to 2 F32T8 lamps EB $95 Kit four F32 lamps with reflector 1 EB	2010	E255	C/I Lighting	830789	Pacific	1/26/2012	Inventoried fixtures.	Mostly	(2) factors out of PSE's control	All found except item IIIc (1 unit). HID conversion to CFL - could not verify that it was done, since they are at the top of the building exterior, and it appears that the original enclosures are still in use. But since most everything else was done, and the work is shown on the contractor's invoice, it was assumed these were too.	Yes
BEM	$60 reduce lamps to 2 F32T8 lamps EB $90 kit four F32T8 lamps EB	2010	E255	C/I Lighting	812366	Tukwila	1/17/2012	Inventoried fixtures.	No	(2) factors out of PSE's control	Two 8' fixtures were not changed because access was blocked at the time.	Yes
BEM	VSD HVAC Fans	2010	E262	Commercial Rebate excl Ltg	829294	Bellevue	12/15/2011	Observation	No	(1) Application error	The application listed 24 drives on the 10-hp motors. Should be 12 drives on the 10-hp motors. Other motor hp drive counts were correct.	Yes

Sector	Measures	Year	Program ID	Domain / Program Element	Project Number (proxy used for REM projects)	Customer City	Date Verified	Verification Activities	Were measures associated with the sampled project implemented as described in project documentation?	If not, was it because of (1) program issues and/or (2) factors out of PSE's control?	If measures installed different than described, describe what was installed	Is the project eligible (e.g., PSE electric customer, measure(s) appropriate to program)?
BEM	$80 Lighting controls rebate	2011	E262	C/I Lighting	845091	Kirkland	12/20/2011	Observation	No	There were two problems uncovered. One seemed to be an application error and the other was site alteration of installed equipment.	The lighting control expected to be observed in the custodian's office was removed recently. The site contact had personal knowledge of the controller previously being used in this location. The controller is now replaced with a simple light switch. There were two controls listed for the library AV Center and only one observed. Additionally, there doesn't seem to be an obvious location to install a second lighting controller in this space. The controller does not appear to have been installed.	Yes

H.RCM program review details

Project Summaries

The 20 RCM project summaries generated as part of the detailed review of the RCM program are provided here. These describe the background, findings, and recommendations the review team developed during the process. These reports are listed in the following order:

SBW ID	Customer type	Type ID	Year	PSE Project Number
783483 - City A - Y1	City	A	1	783483
843607 - City B - Y2	City	B	2	843607
777937 - College A - Y1	College	A	1	777937
804567 - College B - Y1	College	B	1	804567
804570 - College B - Y1	College	B	1	804570
792160 - College C - Y1	College	C	1	792160
814019 - County A - Y1	County	A	1	814019
843604 - County A - Y2	County	A	2	843604
751032 - County B - Y3	County	B	3	751032
841408 - Grocery A - Y4	Grocery	A	4	841408
772109 - Office A - Y1	Office	A	1	772109
772112 - Office A - Y2	Office	A	2	772112
774934 - School District A - Y1	School District	A	1	774934
774938 - School District A - Y2	School District	A	2	774938
747054 - School District B - Y3	School District	B	3	747054
773881 - School District C - RY1	School District	C	1	773881
772063 - School District D - RY3	School District	D	3	772063
825833 - School District E - RY1	School District	E	1	825833
827162 - School District F - RY3	School District	F	3	827162
800479 - School District G - Y1	School District	G	1	800479

783483 - City A

Measure	RCM Salary Guarantee
Sample Year	April 2009 – March 2010
RCM Contract Year1	

Facility portfolio

There are 84 sites in the RCM Grant Agreement, Attachment B - Facility Inventory, including 11 pump stations. Total portfolio square footage is 1,044,075. The pump stations were excluded from year 1 savings analysis because monthly flow data was not available to correlate energy consumption with pumping demand. In total 51 sites with 833,720 square feet were included in the savings analysis.

RCM activities

The grant for this city is based on a 1 FTE RCM.

Attachment A in the Grant Agreement, Section 2, lists the deliverables for Y1. The Y1 salary guarantee performance criterion was met and the grant was paid for this measure.

PSE basis for savings claim

Base Year Electric Usage	13,230,688
Year 1 Claimed Electric Savings	146,004 kWh
Target % Energy Reduction	3%
Achieved % Energy Reduction	3.5%

The savings were calculated using utility data processed through Utility Manager (UM) software. The percent reduction is based on combined electric and gas consumption and savings.

Observations

Information for this review was collected through file reviews, interviews with the RCM and PSE analyst, and a written question and answer exchange with PSE.

The RCM Annual Report to PSE does a good job of providing an overview of RCM activities for the year. The RCM has pushed through retrofit and capital projects that might not have otherwise been accomplished even with rebates and incentives from other PSE programs. The RCM is frustrated that the current method of calculating savings for the RCM program does not give credit for savings achieved from projects that were claimed elsewhere in the PSE portfolio.

Findings regarding accuracy of claimed savings

In the Y1 Regression Summary, six sites had electric savings reduced by 93,554 kWh of ECM savings that were claimed elsewhere in the PSE electric portfolio. Baseline electric consumption was adjusted for weather at nine sites. Those adjustments resulted in a net decrease in the electric savings claim by 47,981 kWh.

There were 19 sites that had negative savings which were zeroed out for the total savings claim calculation. Leaving these negative savers in would reduce the claim by 156,786 kWh The PSE analysts explained that zeroing out negative savers is done to avoid penalizing the RCM for increase in consumption that was beyond their control. However, the performance criterion for the RCM is based on the EUI calculation which includes the negative savers.

Recommendations

Project specific:
Ensure that pump station flow data is available so that energy savings achieved at the pump stations can be included the savings analysis.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year. Furthermore, the performance criteria should be based on percent change in EUI with ECM savings included and negative savers excluded.

Rough engineering savings estimates should be developed for annual RCM energy-related activities by PSE engineers. This would provide a crosscheck with the Utility Manager data and could help inform UM processing, particularly the application of the Avoided Cost Module. Additionally, engineering savings estimates could identify RCM-achieved savings and avoided costs that were otherwise consumed by increased consumption due to activities beyond control of the RCM.

For greater clarity in documentation, analysis workbooks, reports and other critical documents should include a “last revision date” both within the document and in the file name. Additionally, final documents should include “final” in the file name. There should only be one “final” file for each type of document, all other versions should be archived.

843607– City B

Measure	Year 2 Performance Grant
Program Year	July 2009 – May 2010
RCM Contract Year	2

Facility portfolio

There are 18 total sites in the portfolio, but 3 were missing from the Y1 Salary Guarantee analysis workbook for unknown reasons and four more records were removed from the analysis for unspecified reasons. Five records were also missing from the Y2 Performance Grand analysis workbook, but all records present were included in the analysis. The portfolio is a collection of public buildings, including police buildings, community centers, senior centers, etc. The total portfolio floor area for Y1 is 88,252 square feet and for Y2 78,055 square feet.

RCM activities

The FTE RCM grant for this county is unknown.

The Facility Action Plan lists the activities at some of the sites in the portfolio. The grant incentive was not paid for any of the three program years, which probably means that they did not satisfy some part of their performance goals, although there is no documentation of the performance goals or why they did not receive the rebate.

PSE basis for savings claim

	Year 2 Performance
Base Year Electric Usage	Unknown
Savings	125,823 kWh
Target % Energy Reduction	Unknown
Achieved % Energy Reduction	unknown

The savings were calculated using utility data processed through Utility Manager (UM) software. Normalization for weather impacts was applied to some of the sites with a significant correlation between annual weather differences and facilities with electrical or natural gas heating, having a linear regression correlation greater than 70%.

Observations

Information for this review was collected through file reviews, interviews with PSE analysts, and a written question and answer exchange with PSE.

The Facility Action Plan and RCM Annual Report to PSE for these sites provided some overview of RCM activities for the year, but the documentation is unorganized and incomplete. Also, the grant agreement word document and workbook could not be found in order to verify the claimed savings against the projected values and the Utility Usage Savings report for Y2 does not include the same data range as the analysis workbook.

Findings regarding accuracy of claimed savings

The baseline and current year consumption values for Y1 Salary Guarantee analysis workbook matched to the Utility Manager current year and baseline consumption values. The Y1 Salary Guarantee analysis workbook only includes records for 15 sites, even though there are 18 facilities listed in the PSE Grant Buildings Report List, and 4 more were excluded from the analysis because of insufficient baseline data or because the buildings were unoccupied. HDD adjustments were made correctly for all sites with a linear regression correlation greater than 70%, for a net loss of 2,677 kWh. No ECM measures were implemented in the Y1 period, however, there was a floor area adjustment for one site. Lastly, the final claimed savings value excluded all of the “negative” savings records, with a result 3,912 kWh increase in energy savings.

The baseline and current year consumption values for Y2 Performance Grant analysis workbook could not be matched to the Utility Manager current year and baseline consumption values as the two data sets include different time periods, i.e. UM includes July ’08 to June ’10 and the analysis workbook includes the August ’08 to July ’10. The Y2 Performance Grant analysis workbook only includes records for 13 sites, even though there are 18 facilities listed in the PSE Grant Buildings Report List, although, all sites were included in the analysis. The HDD adjustments were applied for some sites, but two HHD adjustments that should have been applied (r^2 = 87% and r^2=80) were not with no explanation why. Again, there were on ECM measures to account for in the analysis, but one site had incomplete baseline data, so an adjustment was made to account for that. As with the Y1 analysis, the final claimed savings value excluded all of the “negative” savings records, with a result 6,951 kWh increase in energy savings.

The method of eliminating negative savers is consistent with PSE’s policy; however, this practice is questionable.

Recommendations

Project specific:
For the Y1 Salary Guarantee, reduce the annual savings from 70,851 kWh to 66,939 kWh by adding back in the negative savers.

For the Y2 Performance Grant, reduce the annual savings from 125,823 kWh to 118,872 kWh by adding back in the negative savers. Make the HHD adjustment to the two additional sites that with the linear regression correlation greater than 70%. Also, provide an explanation of why the remaining facilities in the portfolio have been excluded.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year.

Better organization of the projects and files would be very helpful, especially for a program like this with sub portfolios and many sites per portfolio. A complete RCM Grant Agreement word document and Grant Calculation workbook for each portfolio would provide a baseline and frame of reference for the Y1, Y2, and Y3 claimed savings and whether they satisfied their minimum savings requirement.

777937 – College A

Measures	RCM Y1 Startup Incentive
Sample Year	Y1 – September 2008 to August 2009
RCM Contract Year	1

Note: Y2 savings are also addressed in this report because the Startup Incentive was ultimately based on Y2 savings.

Facility portfolio

There are 28 buildings of several different usage types typical of a university campus listed in the RCM Grant Agreement, Attachment B - Facility Inventory, with a total portfolio square footage of 1,368,484.

In Y1, the buildings listed in the RCM Grant Agreement were separated into five sets of buildings dominated by the main campus with more than 95% of the total square footage. Total building area reported in the Y1 analysis of savings was 1,437,267 square feet. The reason for the discrepancy between the Grant Agreement and the analysis square footage is not clear.

Most heating on the campus is provided by natural gas with some small amount of electric heat.

RCM activities

There was a broad range of well-documented RCM activities. ECM activities were also well documented and accounted for in the Y1 savings analysis.

The grant for this portfolio was based on a 1.5 FTE RCM.

Due to workloads, the RCM was unable to complete preparation of startup documentation within the first year of the program and payment of the startup incentive was delayed pending completion of the Resource Management Plan and the Facility Action Plans. The RCM implemented energy-saving strategies during Y1 and managed to meet the 3% savings goal for electric and natural gas savings combined.

PSE basis for savings claim

Base Year Electric Usage	16,749,450 kWh
Year 1 Claimed Electric Savings	No Savings Claimed for Startup Incentive in Y1
Year 2 Claimed Electric Savings	1,405,312 kWh
Target % Y1 Energy Reduction	3%
Achieved % Y1 Energy Reduction	3.03% (Electric + Gas)
Target % Y2 Energy Reduction	5%
Achieved % Y2 Energy Reduction	9.5% (Electric + Gas)

Per the grant agreement, the deliverables for the Y1 startup incentive were not completed within the allotted six- to nine-month time frame. They were completed during year 2 of the grant period. The startup incentive was delayed until this requirement was completed. Y2 savings were claimed for the startup incentive, after adjusting the total electric savings downward by 199,833 kWh for Y2 RCM accounting software.

Y1 electric energy savings were claimed in the amount of 123,115 kWh under the Y1 performance grant after subtracting 123,608 kWh for Y1 RCM accounting software.

At the end of year 2, the RCM requested payment for the Y2 performance grant. Payment of the Y2 performance grant had been deferred when the Y2 savings were claimed for accounting software and the Y1 startup grant. The Y2 performance grant was re-activated and paid but no energy savings were associated with this payment.

Payments made and savings claimed for Y1 and Y2 were appropriate when considered in total, but were not necessarily paid in the sequence prescribed by the RCM program.

Observations

Information for this review was collected through file reviews, an interview with the RCM and a walkthrough tour of one of the effected buildings.

The Y1 and Y2 Savings Analysis workbooks had footnotes but there was no explanation, if known, for underperforming buildings.

The RCM Annual Reports to PSE do a good job of providing an overview of RCM activities for the year.

Adjustments to HVAC schedules, particularly minimizing morning warm up and cool down times was considered by the RCM to have provided the greatest savings.

In the RCM interview performed as part of this evaluation, the following suggestions were put forth:

1. Allow the RCM to determine which buildings or facilities are to be included in the program. In this case it was felt several small buildings were included with little opportunity to impact the outcome of the project.
2. Contract needs to allow time following the three-year grant period for the RCM to complete the final paperwork instead of within the stated 36 months.
3. Clarification of some of the timing of specific events could be made clearer. For example, the Scope of Work states that the Y1 Performance grant can be paid at the end of a twelve-month period following completion of start-up requirements. The RCM was not sure whether this meant the twelve-month period commenced upon completion of the start-up requirements or if it commenced at the same time the start-up requirements commenced.

Findings regarding accuracy of claimed savings

Adjustments were made to account for heating degree day (HDD) differences between the baseline and Y1 electric energy consumption for two of the smaller buildings. The method used to make these adjustments was not traceable as the adjustment values were hard-coded in the analysis spreadsheet with no indication of their sources. These adjustments reduced the total energy savings obtained by a simple comparison of baseline and Y1 utility-metered data by 4%.

An additional adjustment was made to the energy savings for the main campus to account for central chiller plant capital improvements that were incented under another energy conservation program. The project was reported to have been 90% complete in the baseline year, and the adjustment made was for only one month of the year. The derivation of the adjustment was not provided. This adjustment reduced the savings indicated by the simple difference of utility-metered data by 24%.

In Y2, only HDD adjustments were made to the same two buildings that received the same kind of adjustment in Y1 resulting in a reduction of less than 1% from the utility meter comparison. No other adjustments were made.

While the accuracy of the adjustments described above could not be traced, they are believed to be reasonable and within the accuracy provided by a comparison of utility metered data for two consecutive years.

Recommendations

Project specific:
No changes are recommended to the electric savings for this project.

Structural and systemic issues:
It is recommended that adjustments made to differences in year-to-year utility-metered differences be clearly spelled out and, when possible, the analysis spreadsheets include references to cells in which those adjustment values are determined rather than have hardcoded values entered. Whenever this is not possible due to calculations performed elsewhere, the inputs and results used should be included.

Each subsequent annual analysis should be incorporated into the same workbook used for the previous year's analysis with references to appropriate values in the previous year's analysis (e.g. Y2 baseline metered data should be taken as Y1 current metered data).

Older versions of files should be archived to clearly differentiate between final and earlier versions of analysis workbooks, proposals, standard reporting forms, etc. It is also recommended that a standard folder structure be instituted to help avoid placing standard files in folders where they would not normally be expected (e.g. Y1- or Y2-related files in a Y3-related folder.

804567 – 804570 – College B

Measures	RCM Y1 Startup Incentive
	RCM Y1 Salary Guarantee
Sample Year	Y1 – September 2009 through August 2010
RCM Contract Year	1

Facility portfolio

There are 37 buildings with various usages typical of a community college listed in the RCM Grant Agreement, Attachment B - Facility Inventory, with a total portfolio square footage of 578,993. The buildings were grouped into five groups, the Main Campus accounting for the preponderance of the square footage.

Of the four remaining buildings, two (12% of the total square footage) were not included in the electrical analysis of savings. One small building (0.8% of the total square footage) was dropped from the grant for only the first year of the grant due to significant renovations that caused the building to be shut down for an extended period.

All buildings on the campus were reported to heat with natural gas.

RCM activities

A broad range of RCM activities was identified in the Facility Action Plans for individual buildings, however, no annual RCM report of activities was found in the documentation provided for this evaluation. The Resource Management Plan included news clippings of several implemented projects of interest as an indication of the College's commitment to reducing resource impacts, including energy conservation.

PSE basis for savings claim

Base Year Electric Usage	10,976,214 kWh
Year 1 Claimed Electric Savings	342,511 kWh
Target % Y1 Energy Reduction	3%
Achieved % Y1 Energy Reduction	3.1%

A grant agreement was prepared, including allowances for a startup incentive and a first-year salary guarantee and was presented to the customer in early April of 2008, but was never signed. A subsequent grant agreement, including the startup incentive but not the salary guarantee, was presented to the customer and signed in December of 2009, more than three months into the first-year grant period.

The base year electric usage in the *signed* agreement is 10,094,063 kWh with a savings target of 3%, however the Year 1 analysis was based on the values provided in the table above. The analysis assumed the Year 1 grant period started more than three months prior to the date of the signed agreement.

Observations

Information for this review was collected through file reviews provided by PSE for this evaluation.

Electrical savings analysis was performed for the Main Campus and only one other building. The solitary building was shown to have increased energy consumption by 2.1% during the Year 1 grant period. A footnote in the analysis workbook referenced the building's Facility Action Plan (FAP) as a source of RCM activities, but no explanation was provided for the increase. This increase in consumption was not considered in the determination of the net savings claimed under the RCM grant, however it was considered in determining the achievement of the Year 1 three percent savings target.

The timeline provided below illustrates irregularities in the timing of specific grant events based on reviews of the provided documentation. Notably, the Year 1 grant period started before a grant agreement was signed and savings were claimed for a salary guarantee grant which was absent from the signed agreement (no payment was made for the salary guarantee).

Timeline of Significant RCM Events

8/4/2008	Original Grant Proposal	Startup Incentive and Salary Guarantee included (not signed)
9/1/2009	Year 1 grant period start	
12/14/2009	Revised Grant Proposal	Signed (no Salary Guarantee)
8/31/2010	Year 1 grant period end	Year 1 savings analysis
1/2011	FAPs generated by customer	Various dates in January 2011
4/30/2011	Year 1 RCM inspection by PSE	Basis for Year 1 Salary Guarantee savings claim
5/19/2011	Date of FMP	

Findings regarding accuracy of claimed savings

Because none of the buildings subject to the grant agreement are electrically heated, no weather-related adjustments were made to the raw differences between baseline and Year 1 electric consumption. An adjustment to the raw difference for the main campus was made to account for ECMs that affected energy consumption, reducing the raw difference by 30%.

Energy consumption in the solitary building included in the Year 1 analysis increased by 2.1% over the baseline year. This impact was appropriately included in the determination of the achievement of the Year 1 savings goal of 3%, but was excluded from the determination of net savings used as the basis for savings claims. This exclusion resulted in an increase of 2.7% in claimed savings for Year 1.

Recommendations

Project specific:
Savings claimed under a Year 1 Salary Guarantee should be disallowed as there is no such grant in the signed agreement. Instead, claim 333,476 kWh under the Startup Incentive. This amount takes into account inclusion of the increase in energy consumption for the solitary building analyzed in Year 1.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year.

Startup of an ECM grant should not precede the execution of a signed grant agreement. Milestones to be achieved during the grant period should take place within the constraints of the agreement timelines and values used in the determination of savings should adhere to values designated in the grant agreement. Aberrations from these times and values should be clearly explained in the analysis workbooks. Only those grants defined in the RCM grant agreement should be used as the basis for claiming savings and making payments. In short, grant agreements should be adhered to unless extenuating circumstances prevent such adherence, in which case clear explanations of those circumstances and the rationale for changes should be provided.

For greater clarity in documentation, analysis workbooks, reports and other critical documents should include a “last revision date” both within the document and in the file name. Additionally, final documents should include “final” in the file name. There should only be one “final” file for each type of document, all other versions should be archived.

Consider identifying a randomly-selected control group of non-participating facilities of the same category as a participating grant recipient to provide an initial baseline adjustment to account for changes in building operator and occupant behavior that is influenced by the awareness of issues of resource conservation. The control group could be selected from current PSE customers. This approach could account for general attitudinal changes among facilities of a particular type outside RCM influence.

792160 – College C

Measure	RCM Salary Guarantee
Sample Year	October 2009 – September 2010
RCM Contract Year	Year 1

Facility portfolio

There are 12 buildings in the RCM Grant Agreement, Attachment B - Facility Inventory. The buildings comprise most of a community college campus. Total portfolio square footage is 308,558. A 19,000 Ft^2 building had a significant change in use in Y1 and was excluded from the Y1 annual savings analysis.

RCM activities

This college shares a .5 FTE RCM position with another college in the area. This college's share is .29 FTE.

Attachment A in the Grant Agreement, Section 2, lists the deliverables for Y1. Per a note on PSE's QC Review Form – RCM Grant Payment/Savings, not all deliverables were completed; consequently the Y1 grant was not paid.

PSE basis for savings claim

Base Year Usage	3,461,847 kWh
Year 1 Claimed Savings	138,593 kWh
Target % Energy Reduction	3%
Achieved % Energy Reduction	3.82%

The savings were calculated using utility data processed through Utility Manager software. PSE chose not to apply normalization for weather impacts.

The Year 1 True-Up memo summarized the nature of the Y1 savings:

> *Fine-tuning and enhancing HVAC and electrical system scheduling has had the most impact in terms energy use. Updated filter-changing timing and procedures likely also have had an appreciable effect on the operational efficiency of our air handlers for each site as well, but scheduling was the big winner in terms of savings.*

Utility Manager output data was provided for each building in the portfolio.

Observations

Information for this review was collected through file reviews and a written question and answer exchange with PSE.

The RCM Annual Report to PSE did a good job of providing an overview of RCM activities for the year

Findings regarding accuracy of claimed savings

In the Y1 Regression Summary, four buildings which used more energy than the comparison year were not counted in the Year 1 savings claim. PSE responded to this observation in reviewing notes from a meeting where the issue was briefly discussed.

> *These four sites were not "zeroed out." They were factored into the overall EUI change in use, but we claim the total savings attributed to the RCM independent of increases in usage. This is the reason for the "savings only" column and totals in the summary spreadsheets.*

It's good that the buildings with negative savings were accounted for in the EUI as that is a contract performance metric. The kWh savings claim is both a project and a program performance metric and probably should reflect the entire portfolio's performance.

Recommendations

Project specific:
Reduce the annual savings from 138,593 kWh to 132,304 kWh by adding back in the buildings with negative savings in the Regression Summary workbook.

Structural and systemic issues:
It is recommended that the policy of counting only buildings which show positive savings is changed to sum adjusted savings for all buildings in the portfolio, both positive and negative values – unless a particular building is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year.

814019 & 843604– County A

Measure	Year 1 Salary Guarantee	Year 2 Performance Grant
Program Year	July 2008 – May 2009	July 2009 – May 2010
RCM Contract Year	1	2

Facility portfolio

There are 40 total sites in the portfolio; 10 were excluded from the Y1 Salary Guarantee analysis because there was insufficient usage data for the entire two year period to make a comparison and 4 were excluded from the Y2 Performance Grant for the same reason. The portfolio is a collection of public buildings, including government buildings, community centers, parks and recreation offices, etc. The total portfolio floor area for Y1 is 417,388 square feet and for Y2 423,878 square feet.

RCM activities

The FTE RCM grant for this county is unknown.

The Skagit County Facility Action Plan lists the activities at some of the sites in the portfolio. The grant incentive was not paid for any of the three program years, probably means that they did not satisfy some part of their performance goals, although there is no documentation of the performance goals or why they did not receive the rebate.

PSE basis for savings claim

	Year 1 Salary Guarantee	Year 2 Performance Grant
Base Year Electric Usage	Unknown	Unknown
Savings	161,854 kWh	453,722 kWh
Target % Energy Reduction	Unknown	Unknown
Achieved % Energy Reduction	Unknown	Unknown

The savings were calculated using utility data processed through Utility Manager (UM) software. Normalization for weather impacts was applied for sites with a significant correlation between annual weather differences and facilities with electrical or natural gas heating, having a linear regression correlation greater than 70%.

Observations

Information for this review was collected through file reviews, interviews with PSE analysts, and a written question and answer exchange with PSE.

The Facility Action Plan and RCM Annual Report to PSE for these sites provide some overview of RCM activities for the year, but the documentation is unorganized and incomplete. Also, the grant agreement word document and workbook could not be found in order to verify the claimed savings against the projected values.

Findings regarding accuracy of claimed savings

The HDD adjustments for both program years were applied correctly for all sites with a linear regression correlation greater than 70%. The Y1 Salary Guarantee analysis workbook only includes records for 37 sites, even though there are 40 facilities listed in the PSE Grant Buildings Report List, and 7 more were excluded because there was insufficient usage data available during the 2-year time frame to make a reliable comparison. The rebated ECM measure savings was subtracted from the RCM program energy savings and an occupancy and a floor area adjustment were made for two records. Lastly, the final claimed savings value excluded all of the "negative" savings records and, I believe inadvertently, excluded two positive savings values. The result was a 10,700 kWh increase in energy savings.

For the Y2 Performance Grant analysis, the workbook again only contained 37 sites and one was excluded from the analysis because of insufficient usage data available during the 2-year time frame. The Y2 program had one ECM measure, which they accounted for in the saving analysis and they made an occupancy adjustment for two records. Again, the final claimed savings excluded all of the negative savings records as well, resulting in a 56,577 kWh increase in energy savings.

The method of eliminating negative savers is consistent with PSE's policy; however, this practice is questionable.

Recommendations

Project specific:
For the Y1 Salary Guarantee, reduce the annual savings from 161,158 kWh to 151,684 kWh by adding back in the negative savers and the two positive savers in the analysis workbook. Also, provide an explanation of why the remaining facilities in the portfolio were not included in the analysis.

For the Y2 Performance Grant, reduce the annual savings from 453,722 kWh to 397,145 kWh by adding back in the negative savers. Also, provide an explanation of why the remaining facilities in the portfolio were not included in the analysis.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year.

Better organization of the projects and files would be very helpful, especially for a program like this with sub portfolios and many sites per portfolio. A complete RCM Grant Agreement word document and Grant Calculation workbook for each portfolio would provide a baseline and frame of reference for the Y1, Y2, and Y3 claimed savings and whether they satisfied their minimum savings requirement.

751032 – County B

Measure	RCM Software Maintenance Agreement
Sample Year	July 2009 – June 2010
RCM Contract Year	Year 3

Facility portfolio

The RCM grant agreement with a county government listed 78 sites in the RCM Grant Agreement, Attachment B - Facility Inventory. Some of the site names do not appear to be buildings, possibly PSE meters for various types of non-building county infrastructure. PSE's Y3 Regression Analysis workbook lists 39 facilities for savings tracking. The grant agreement did not record portfolio square footage.

RCM activities

The grant agreement is for a .35 FTE RCM position.

The county's Y3 Annual Report indicated the RCM was no longer employed by the county but the RCM duties where being shared by three divisions, Administration, Finance, and Facilities. The report went on to list a range of RCM related activities which had been carried out over the past year. Activities were also listed which were specific to the RCM Software Maintenance Agreement measure.

PSE basis for savings claim

Base Year Usage	6,095,172 kWh
Year 3 Claimed Savings	172,956 kWh
Target % Reduction	3.3%
Achieved % Reduction	3.1%

The savings were calculated using utility data processed through Utility Manager software. Some sites were weather-normalized and others were not. One site's savings were reduced to compensate for a PSE-funded lighting retrofit project.

Whatcom County's RCM program achieved 129,854 kWh in total savings during year. 43,102 kWh in additional savings were claimed during year 3 because they were realized but accidentally omitted during year 2. The claimed savings fell slightly short of the Y3 goal but the overall 3 year goal was exceeded by 10.7 %.

The target reduction of 3.3 % differs from the 5% presently assigned to grant years 2 and 3 because a different method of assigning savings targets was in effect in 2006 when this grant agreement was written.

Observations

Information for this review was collected through file reviews and conversations with PSE staff.

The RCM Annual Report from the county to PSE was adequate.

Findings regarding accuracy of claimed savings

In the Y3 Regression Summary, 13 buildings out of 39 used more energy than the comparison year and were not counted in the Y3 savings claim. The adjusted savings with these buildings added back in would reduce the Y3 savings claim to 63,093, a reduction of about 50%.

Recommendations

Project specific:
Reduce the annual savings from 129,854 kWh to 63,093 kWh by adding back in the buildings with negative savings in the Regression Summary workbook.

Structural and systemic issues:
It is recommended that the policy of counting only buildings which show positive savings be changed to sum adjusted savings for all buildings in the portfolio, both positive and negative values – unless a particular building is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year.

841408 – Grocery A

Measures	RCM Y4 Salary Guarantee
Sample Years	Y4 – June 2009 to May 2010
RCM Contract Year	4

Facility portfolio

There are 75 grocery stores in the RCM Grant Agreement, Attachment B - Facility Inventory, with a total portfolio square footage of 2,415,338. The portfolio is owned by a large grocery store chain.

In Y4, 64 sites with 2,219,320 square feet were included in the savings analysis. Store closings over the course of the grant program account for the differences between the Y1 AND Y4 quantities.

RCM activities

The grant for this portfolio was based on a 1.0 FTE RCM. No dedicated RCM was in place for Y2 and Y3 of the grant period. RCM duties were again assumed in March of 2009 and a report for Y3 was prepared. Many of the Y4 RCM activities were reported as occurring in Y3. The Y4 report claimed energy savings but no salary guarantee was paid to the customer.

PSE basis for savings claim

Base Year Electric Usage	53,028,240 kWh
Year 4 Claimed Electric Savings	483,519 kWh
Target % Y4 Energy Reduction	No target specified
Achieved % Y4 Energy Reduction	0.9%

A Year 4 savings analysis with a zero incentive Salary Guarantee was performed to claim RCM savings for this grant. No target savings value was specified for Y4, however, savings targets for Years 1 – 3 were specified at 1%, 1.7% and 1.7%, respectively.

Savings were calculated by forcing a linear regression fit between average monthly temperature and electric energy consumption for each store with electrical impacts under the RCM grant. Before taking the difference in energy consumption between the baseline year and current year energy consumption, the baseline year data were adjusted using the results of the regression. The resulting difference was further adjusted by subtracting savings realized for energy conservation measures (ECMs) installed with incentives from other (i.e. non-RCM) PSE programs.

The Y4 Savings Analysis workbook reports savings of 483,519 kWh, which is 0.9% of the weather-adjusted baseline. This savings value excludes those stores in which electric energy consumption was found to increase when the calculation approach described above is employed. If all stores are included, a total increase of 739,591 kWh results, which is a 1.4% increase in electric energy consumption.

Observations

Information for this review was collected through the review of files provided by PSE. The Year 4 extension was set up solely to claim savings and did not include any payments associated with the original grant. As a result, the set of files generated for Year 4 were not as robust as is normally the case for RCM grants. Detailed documentation of RCM activities was generated for Year 3 when the RCM position was reinstated. In a QC Review Form prepared for Year 4, it was stated that those activities are "…more applicable to Year 4…". This makes sense given the timing of the reinstatement of the RCM position as April of 2009.

Of the 64 stores listed in the Y4 analysis workbook, 30 had entries of "N/A" for entries associated with electrical consumption or savings. Of the remaining 34 stores, decreases in energy following the weather and ECM adjustments were found for 15, the remaining 19 all showing increases in energy consumption. Footnotes described partial-year credits for four stores that closed during Year 4 and two stores had increases in energy consumption following significant remodels.

Findings regarding accuracy of claimed savings

Claimed savings for Year 4 included only those stores for which savings were achieved. If the stores showing increases in energy consumption are included, the claimed energy savings of 483,519 kWh becomes an energy increase of 739,591 kWh. No rationale was provided for excluding the stores whose energy consumption increased.

The appropriateness of the weather adjustments made to the baseline energy for each store could not be determined because the adjustment values were hard-coded into the analysis workbook. The only reference to their source was a statement that the adjustment was based on a forced correlation to average monthly temperatures at the customer's request, due to the fact that refrigeration in the stores is affected by outside air temperatures.

Corrections made to account for energy savings realized from ECMs installed under other programs appear to be correct. They are simple subtractions based on savings claimed under PSE's EnergySmartGrocer program.

Recommendations

Project specific:
Change the annual savings in the Y4 Savings Analysis workbook from 483,519 kWh to -739,591 kWh by adding back in the buildings with negative savings.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year. Furthermore, the performance criteria should be based on percent change in EUI with ECM savings included and negative savers excluded.

In general, consideration should be given to closing out grants for customers that do not fulfill the duties of the RCM as described in the grant agreement. Reinstituting the grant could be allowed in exceptional cases, but failure to adhere to the program requirements is an indicator of the customer's lack of motivation to participate. If reinstituted, a new agreement based on the original should specify a new baseline period and the duration of the remainder of the grant. The objective would be to finish a complete 3-year period even though not a continuous one.

772109 & 772112 Office A

Measures	RCM Y1 Salary Guarantee
	RCM Y2 Performance Incentive
Sample Years	Y1 – July 2008 to June 2009
	Y2 – July 2009 to June 2010
RCM Contract Years	1 & 2

Facility portfolio

There are 20 commercial office buildings listed in the RCM Grant Agreement, Attachment B - Facility Inventory, with a total portfolio square footage is 2,246,737. The portfolio is owned by a large financial services organization.

In Y1, 16 sites with 894,762 square feet were included in the savings analysis. Four buildings were removed from the portfolio which had electrical service from other utilities.

In Y2, due to the sale of one set of properties, the portfolio was reduced to 7 sites with 539,000 square feet.

RCM activities

There was broad range of well-documented RCM activities.

The grant for this portfolio was originally based on a 1.25 FTE RCM, however the Y2 QC Review Form and RCM Grant True-Up form indicates the grant was reduced to a .75 FTE due to the reduced size of the portfolio.

PSE basis for savings claim

Base Year Electric Usage	13,230,688 kWh
Year 1 Claimed Electric Savings	620,966 kWh
Year 2 Claimed Electric Savings	642,441 kWh
Target % Y1 Energy Reduction	3%
Achieved % Y1 Energy Reduction	4.1%
Target % Y2 Energy Reduction	5%
Achieved % Y2 Energy Reduction	3.6%

Per the grant agreement, the deliverables for the Y1 salary guarantee were met and the grant paid. The Y2 performance incentive grant was paid but reduced proportionally to the reduction in the FTE hours.

Savings were calculated using utility data processed through Utility Manager (UM) software. For some properties, savings were weather normalized. The percent reduction is based on combined electric and gas consumption and savings.

The savings at the end of Y2, through June 2010, were 3.6%. By the end of August, 2010, annual usage was 5% below the fixed base year, so the performance incentive was paid early in Y3.

Observations

Information for this review was collected through file reviews, an interview with the RCM, and the chief engineer at one site.

The Y1 and Y2 Savings Analysis workbooks had footnotes but there was no explanation, if known, for underperforming buildings.

The RCM Annual Reports to PSE do a good job of providing an overview of RCM activities for the year.

The RCM suggested creating on-line forums for RCMs so they can post their experiences, questions, obstacles they are facing, success stories, and share ideas. Additionally, he suggested forums for dialogue between RCMs with similar types of property portfolios. This could help spur more creative ideas that would be applicable to each RCM customer type.

The chief engineer of the properties where the site visit was conducted noted that the portfolio owner's policy is that all buildings be Energy Star rated. He said the RCM program and Energy Star activities are complimentary.

Findings regarding accuracy of claimed savings

Adjustments were made to individual building savings data in both the Y1 and Y2 baseline years to compensate for significant changes in building occupancy levels. There was limited documentation on the adjustments. (PSE reported Avoided Cost Module documentation was available in hard copy and would have provided sufficient detail, but wasn't reviewed before publication of this report).

Revising baseline building energy data to adjust for occupancy had limited documentation but appeared to have a fairly basic approach. The chief engineer at one site where HVAC zone temperature setpoints were deeply setback to conserve energy in unoccupied areas related the complexities inherent in such an aggressive strategy. He described having to override controls in hotter and colder weather conditions to avoid losing control of the building and to avoid being unable to maintain temperature setpoints in occupied areas of the building. It isn't clear if the adjustment to the baseline data for occupancy under or overestimated the energy impacts of the situation.

The Y1 adjusted portfolio savings (prior to backing out software and start-up incentive savings) of 1,244,210 kWh would have been reduced to 193,689, had buildings with negative savings been counted. Similarly, in Y2, adjusted portfolio savings included only sites with positive savings, omitting buildings which used more energy than the comparison year.

Recommendations

Project specific:

For Y1, reduce the annual savings in the Savings Analysis workbook from 1,244,210 kWh to 193,689 kWh by adding back in the buildings with negative savings. For Y2, reduce the savings from 642,441 kWh to 486,193 kWh for the same reason.

Revising baseline building energy data to adjust for occupancy should reflect the application of best practice engineering principles and rigor applied to well-documented methodologies. This operations practice is worthwhile but can be complex and nuanced; modifying baseline data to reflect these practices should also be carefully considered and documented.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year. Furthermore, the performance criteria should be based on percent change in EUI with ECM savings included and negative savers excluded.

Documentation of achieved percentage energy savings should be better documented to avoid the ambiguity encountered in this case.

For greater clarity in documentation, analysis workbooks, reports and other critical documents should include a “last revision date” both within the document and in the file name. Additionally, final documents should include “final” in the file name. There should only be one “final” file for each type of document, all other versions should be archived.

774934 & 774938– School Dist A

Measure	Year 1 Salary Guarantee	Year 2 Performance Grant
Program Year	Sept 2008 – Aug 2009	Sept 2009 – Aug 2010
RCM Contract Year	1	2

Facility portfolio

There are 40 total sites in this school district portfolio, but 10 were excluded from the Y1 Salary Guarantee analysis because there was insufficient usage data for the entire two year period to make a comparison and 4 were excluded from the Y2 Performance Grant for the same reason. The total portfolio floor area for Y1 is 417,388 square feet and for Y2 423,878 square feet.

RCM activities

The FTE RCM grant for this county is .5.

The Facility Action Plan lists the activities at some of the sites in the portfolio. The grant incentive of $1400 was paid for Y1 Start-up Incentive and $1400 for the Y2 Performance grant, but they did not pay the Y1 Salary Guarantee. There is a note in the Grant Calculation workbook that says a project must have a full FTE to qualify for the Salary Guarantee Incentive.

PSE basis for savings claim

	Year 1 Salary Guarantee	Year 2 Performance Grant
Base Year Electric Usage	13,279,749 kWh	13,014,154 kWh
Savings	445,861 kWh	597,032 kWh
Target % Energy Reduction	2%	3.5%
Achieved % Energy Reduction	3.36%	4.59%

Unlike the other programs, this project had an estimated savings of 2% for the first year and 3.5% for the subsequent two years. The savings were calculated using utility data processed through Utility Manager (UM) software. Normalization for weather impacts was applied for sites with a significant correlation between annual weather differences and facilities with electrical or natural gas heating, having a linear regression correlation greater than 70%.

Observations

Information for this review was collected through file reviews, interviews with PSE analysts, and a written question and answer exchange with PSE.

The Facility Action Plan and RCM Annual Report to PSE for these sites provide a good overview of RCM activities for the year. This project was better documented than some of the other projects with clear explanations of the analysis steps.

Findings regarding accuracy of claimed savings

The Y1 Salary Guarantee analysis workbook includes records for 28 sites, but 1 site has only a partial year analysis due to school closure. The HDD adjustments for Y1 Salary Guarantee analysis were applied correctly for all sites with a linear regression correlation greater than 70%, resulting in a net savings loss of 39,232 kWh. There is no mention of rebated ECM measures in the analysis workbook and no other site level savings adjustments, but the savings already claimed for the Start-up Incentive, training and software maintenance were subtracted from the Y1 Salary Guarantee claimed savings. The final claimed savings value excluded all of the “negative” savings record, resulting in a 76,957 kWh increase in energy savings.

For the Y2 Performance Grant analysis, the workbook included 25 sites, with three sites that had closed down excluded from the list. The HDD adjustments for Y2 Performance Grant analysis were applied for all sites with both a linear regression correlation greater than 70% and electric heat, although this criterion had not been applied in the previous year analysis. This resulted in a loss of 75,278 kWh. There is no mention of rebated ECM measures in the analysis workbook and no other site level savings adjustments are made, but the savings claimed due to software maintenance were subtracted from the Y2 Performance Grant claimed savings. Again, the final claimed savings excluded all of the negative savings records as well, resulting in a 98,738 kWh increase in energy savings.

The method of eliminating negative savers is consistent with PSE’s policy; however, this practice is questionable. The method of only applying HDD adjustments for electrically heated sites has also been seen at other sites, but it is not consistently used at this site and the rationale may also be questionable.

Recommendations

Project specific:
For the Y1 Salary Guarantee, reduce the annual savings from 445,861 kWh to 368,904 kWh by adding back in the negative savers.

For the Y2 Performance Grant, reduce the annual savings from 597,032 kWh to 498,294 kWh by adding back in the negative savers.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year.

747054 - School District B - Y3

Measure	RCM Salary Guarantee
Sample Year	September 2008 – August 2009
RCM Contract Year	3

Facility portfolio

There are 32 facilities in the RCM Grant Agreement, Attachment B - Facility Inventory. Total portfolio square footage is 2,513,077. Year 3 savings claim is for 17 facilities, two of which were not in the original portfolio square footage.

RCM activities

This school district employees 1 FTE RCM.

Attachment A in the Grant Agreement, Section 2, lists the deliverables for Y3. According to the QC Review Form RCM Grant True-up document, deliverables had not been met by the end of the grant period and PSE allowed for deliverables to be met under a new contract. PSE did not pay the Y3 grant.

PSE basis for savings claim

Base Year Electric Usage	7,392,066 kWh
Year 3 Claimed Electric Savings	283,928 kWh
Target % Energy Reduction	5%
Achieved % Energy Reduction	2.8%

The savings were calculated using utility data processed through Utility Manager (UM) software. The percent reduction is based on combined electric and gas consumption and savings.

Observations

Information for this review was collected through file reviews.

Generally, documentation was sparse, particularly for Y3. The RCM submitted supporting documents such as Site Inspection Summary for Personal Equipment & Appliances and a Projects List to PSE in lieu of an Annual Report and other deliverables. The savings analysis workbook is well annotated and matches the claimed savings.

Findings regarding accuracy of claimed savings

In the Y3 Regression Summary in the savings analysis workbook, two schools had baseline electric consumption reduced by 52,194 kWh and caused one school to go from positive to negative savings. Five schools met the criteria for making weather-based adjustments to their baseline but the original baselines were kept because they are gas-heated schools. The PSE analyst noted that the apparent weather correlation was more likely due to student load; however, it seems there could still be weather-related impacts to heating season electric consumption such as fan energy that are being left out by not taking the HDD adjustment.

There were six schools that had negative savings zeroed out for the total savings claim calculation, reducing the claimed savings amount by 308,639 kWh which leaves a net savings of -15,079 kWh. For one of the schools, a valid explanation was given for the exclusion of its negative savings (-32,267 kWh) but not the others.

Recommendations

Project specific:
Reduce the annual savings claim from 283,928 kWh to 17,188 kWh to include the four schools with unexplained negative savings.

The regression analysis should allow for monthly adjustment such that weather-related impacts to heating season electric consumption can be taken into account.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year. Furthermore, the performance criteria should be based on percent change in EUI with ECM savings included and negative savers excluded.

For greater clarity in documentation, analysis workbooks, reports and other critical documents should include a “last revision date” both within the document and in the file name. Additionally, final documents should include “final” in the file name. There should only be one “final” file for each type of document, all other versions should be archived.

773881 – School District C

Measure	RCM Renewal Performance Incentive
Sample Year	July 2009 – June 2010
RCM Contract Year	Renewal Year 1 (R-Y1)

Facility portfolio

The RCM grant agreement with this school district listed 48 sites in the RCM Grant Agreement. The portfolio is mostly schools followed by administration and support facilities.

RCM activities

The grant agreement is for one full time RCM position.

The school district's R-Y1 Annual Report indicates a broad range of RCM activities.

PSE basis for savings claim

Base Year Usage	33,871,069 kWh
Year 1 Claimed Savings	2,022,102 kWh
Target % Energy Reduction	5.0 %
Achieved % Energy Reduction	5.6 %

The claimed savings exceeded the R-Y1 goal.

The savings were calculated using utility data processed with Utility Manager software. For most sites, electrical savings were adjusted by normalizing for weather. Ten of the sites had negative electrical savings and were omitted from the final savings claim. One school's savings were reduced to compensate for a PSE-funded energy retrofit project and another school was removed from the portfolio because it was under construction for part of the year.

There were substantial footnotes in the Y1 analysis workbook to explain significant changes in savings and, overall, PSE and RCM documentation was excellent.

Observations

Information for this review was collected through file reviews.

The RCM Annual Report from the school district to PSE provided good high level program information but documentation of site-level work was uneven.

Findings regarding accuracy of claimed savings

The savings claim appears to be accurate.

Recommendations

None

772063 - School District D

Measure	RCM Performance Incentive
Sample Year	September 2009 – August 2010
RCM Contract Year	Renewal Year 3

Facility portfolio

There are 40 schools in the RCM Grant Agreement, Attachment B - Facility Inventory, but years 2 and 3 include an additional non-school building. Total portfolio square footage is 3,251,852. One school (355,950 sq ft) is not included in the savings analysis because it was not in operation in year 1 and 2 and did not have a base year against which to compare year 3.

RCM activities

This school district contracts for a 1.5 FTE RCM position with a consulting firm that specializes in resource conservation.

Attachment A in the Grant Agreement, Section 2, lists the deliverables for Y3. The deliverables were met and PSE paid the Y3 grant to the school district.

PSE basis for savings claim

Base Year Electric Usage	28,958,285 kWh
Year 3 Claimed Electric Savings	2,790,114 kWh
Target % Energy Reduction	5%
Achieved % Energy Reduction	9.4%

The savings were calculated using utility data processed through Utility Manager (UM) software. The percent reduction is based on combined electric and gas consumption and savings.

Observations

Information for this review was collected through file reviews, an interview with the RCM, and a written question and answer exchange with PSE.

The RCM Annual Report to PSE does a good job of providing an overview of RCM activities for the year. The RCM is enthusiastic and is having great success conserving resources in part due to effective communication with maintenance staff and other facilities personnel. The RCM has also pushed through retrofit and capital projects that might not have otherwise been accomplished even with rebates and incentives from other PSE programs. The RCM provides consultation to designers of new facilities, frequently altering designs to be more energy efficient. The RCM is frustrated that the current method of calculating savings for the RCM program does not give credit for savings achieved from projects that were claimed elsewhere in the PSE portfolio.

Findings regarding accuracy of claimed savings

In the Y3 Regression Summary, nine schools had electric savings reduced by 218,174 kWh of ECM savings that were claimed elsewhere in the PSE electric portfolio. Baseline electric consumption was adjusted for weather at nine schools, for square footage at one school, and for solar power at three schools. Those adjustments resulted in a net decrease in the electric savings claim by 532,404 kWh.

Eleven schools met the criteria for making weather-based adjustments to their baseline but the original baselines were kept because they are gas-heated schools. If the adjustments had been taken, the electric savings claim would have been further reduced by 113,066 kWh. The PSE analysts explained that the adjustments were not taken because the majority of the weather correlation is due to the schools being unoccupied during the summer; however, it seems there could still be weather-related impacts to heating season electric consumption such as fan energy that are being left out by not taking the HDD adjustment. One electric-heated school that had strong correlation with weather did not take the adjustment and provided no explanation. The adjusted baseline would have further reduced the electric savings claim by 12,332 kWh.

One other school used an adjusted baseline that was different from the value in the UM report which reduced the electric savings claim by 11,808 kWh. No documentation was found for this adjustment but further discussion with PSE staff revealed it was for solar power.

There were two schools for which the sign on the savings was reversed which resulted in increasing the electric savings claim by 67,476 kWh. This appears to have been a calculation error. If the savings had been calculated consistent with the method used for other schools and other years, these two schools would have had negative savings. It was observed that in years 1 and 2, there were several schools that had negative savings which were zeroed out for the total savings claim calculation. This practice is not consistent with the standard practice used in other DSM programs. The PSE analysts explained that zeroing out negative savers is done to avoid penalizing the RCM for increase in consumption that was beyond their control. However, the performance criterion for the RCM is based on the EUI calculation which includes the negative savers.

Recommendations

Project specific:

Reduce the annual savings claim from 2,790,114 kWh to 2,710,306 kWh by removing the two schools with calculation error and adjusting the savings for the electric-heated school for which the weather adjustment was not taken. Savings should be further reduced by some fraction of the 113,066 kWh that would have reduced the baseline consumption had the eleven gas-heated schools taken the weather adjustment.

The regression analysis should allow for monthly adjustment such that weather-related impacts to heating season electric consumption can be taken into account.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year. Furthermore, the performance criteria should be based on percent change in EUI with ECM savings included and negative savers excluded.

For greater clarity in documentation, analysis workbooks, reports and other critical documents should include a "last revision date" both within the document and in the file name. Additionally, final documents should include "final" in the file name. There should only be one "final" file for each type of document, all other versions should be archived.

825833 - School District E

Measures	RCM Salary Guarantee
Sample Year	July 2007 to August 2008
RCM Contract Years	Year 1

Facility portfolio

This portfolio is owned by a school district with 29 buildings with PSE electrical and/or natural gas service of which 23 are schools have PSE electrical service. The total portfolio square footage is 2,277,081. The 23 schools with PSE electrical service were evaluated in the 2007-2008 time period.

RCM activities

Documentation on RCM activities was not available as the Y1 Activity folder contained only Y2 documents.

The grant for this portfolio was based on one full time FTE.

PSE basis for savings claim

Base Year Electric Usage	15,706,825k
Year 1 Claimed Electric Savings	711,667
Target % Renewal Contract Energy Reduction	5%
Achieved % Y1 Energy Reduction	4.7%

The savings were claimed 6/4/2010 for this 2007-2008 salary guarantee. Per the Verification/Payment Request, no grant was paid as part of this claim, but was a verification of savings achieved in Y1 under the previous grant agreement. The full salary guarantee grant of $20,000 for the three year grant agreement was paid in 2010 under that grant agreement. It isn't clear why this claim was part of the following renewal agreement. This claim appears to be a true-up several years after the fact.

Savings were calculated using utility data processed through Utility Manager (UM) software. For some sites, savings were weather normalized. The percent of energy reduction is based on combined electric and gas consumption and savings.

Observations

Information for this review was collected through file review.

The Y1 Activity folder contained only Y2 documents.

There was a poorly organized collection of files, most for Y2, but some files with limited Y1 data included, which provided ongoing evidence of RCM activities.

Findings regarding accuracy of claimed savings

The claimed savings of 711,667 kWh does not take into account the sites which did not save energy. If those buildings are counted, the portfolio savings are 559,213 kWh.

Adjustments were made to account for heating degree day (HDD) differences between the baseline and Y2 electric energy consumption for a number of buildings with electric heat. The method used to make these adjustments was not traceable as the adjustment values were hard-coded in the analysis spreadsheet with no indication of their sources.

While the accuracy of the adjustments described above could not be traced, they are believed to be reasonable and within the accuracy provided by a comparison of utility metered data for two consecutive years.

Recommendations

Project specific:
For Y1, reduce the claimed savings from 711,667 by 152,454 kWh to 559,213 kWh to account for the buildings with negative savings.

Structural and systemic issues:
It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year. Furthermore, the performance criteria should be based on percent change in EUI with ECM savings included and negative savers excluded.

Documentation of achieved percentage energy savings should be better documented to avoid the ambiguity encountered in this case.

For greater clarity in documentation, analysis workbooks, reports and other critical documents should include a “last revision date” both within the document and in the file name. Additionally, final documents should include “final” in the file name. There should only be one “final” file for each type of document, all other versions should be archived.

827162 – School District F

Measure	Y3 Performance Incentive
Sample Year	September 2009 to August 2010
RCM Contract Year	2

Facility portfolio

There are 20 school district buildings listed in the RCM Grant Agreement with a total portfolio square footage of 1,325,407; 19 of those buildings were evaluated for savings in this period.

RCM activities

There was a broad range of well documented RCM activities.

The grant for this portfolio was based on a .75 FTE RCM and was the third performance grant for this school district.

PSE basis for savings claim

Base Year Electric Usage	12,798,039 kWh
Year 3 Claimed Electric Savings	596,701 kWh
Target % Energy Reduction	5%
Achieved % Y3 Energy Reduction	11.2%

This 3 year renewal agreement was terminated one year early in 2010 because the three year 5% performance goal was met in Y2.

Savings were calculated using raw utility data processed through Utility Manager (UM) software. For some sites, savings were weather normalized. Sites were also adjusted if capital measures were installed. Savings associated with the UM software and RCM training were deducted from the net adjusted savings. The percent energy reduction is based on combined electric and gas consumption and savings.

Observations

Information for this review was collected through file review and a discussion with PSE.

File folder and file naming created confusion for the reviewer, for instance, the renewal Y3 claim, done in Renewal Year 2, had a savings analysis workbook named (facility name deleted) *YR 1 Savings_Renewal_3.15.2011.xls.* Program staff helped explain and sort out the confusion. File names aside, the level of project documentation was good.

In addition to the PSE's Annual Report to PSE document the RCM submitted a detailed annual report/FAP which was exemplary.

Findings regarding accuracy of claimed savings

Adjustments were made to account for heating degree day (HDD) differences between the baseline and Y2 electric energy consumption for a number of buildings with electric heat. The method used to make these adjustments was not traceable as the adjustment values were hard-coded in the analysis spreadsheet with no indication of their sources.

While the accuracy of the adjustments described above could not be traced, they are believed to be reasonable and within the accuracy provided by a comparison of utility metered data for two consecutive years.

Consistent with PSE policy, sites with negative savings were removed from the electric savings claim.

Recommendations

Project specific:

It is recommended that the negative savings attributed to the sites which did not save electrical energy be added back into the claim which would reduce the claim of 596,701 kWh by 232,006 kWh to 364,695 kWh.

Structural and systemic issues:

It is recommended that adjustments made to differences in year-to-year utility-metered differences be clearly spelled out and, when possible, the analysis spreadsheets include references to cells in which those adjustment values are determined rather than have hardcoded values entered. Whenever this is not possible due to calculations performed elsewhere, the inputs and results used should be included.

File and file folder naming conventions should be standardized and rigorously checked as quality control.

800479 – School District G

Measure	RCM Program Start-up Incentive
Sample Year	Sept 2009 – Aug 2010
RCM Contract Year	1

Facility portfolio

There are 9 sites in the portfolio, 8 of which are schools and 1 support services building. The total portfolio area is 575,776 square feet. The RCM Program Start-up Incentive is based on ½ of the year 1 projected savings of 3% of baseline usage, so 1.5% of baseline usage.

RCM activities

The grant for this school district is based on a .5 FTE RCM.

Attachment A in the Grant Agreement, Section 2, lists the deliverables for the Start-up Incentive. The Program Start-up Incentive performance criterion was met and the grant was paid for this measure of $8,073.

PSE basis for savings claim

Base Year Electric Usage	9,923,463 kWh
Start-up Incentive Electric Savings	140,412 kWh
Target % Energy Reduction	1.5%
Achieved % Energy Reduction	1.4%

These savings were based on an estimate of 1.5% of the baseline usage. The baseline usage was found to be slightly higher than originally estimated, bringing the percent savings of the Start-up Incentive down slightly.

Observations

Information for this review was collected through file reviews, on-site inspection, interviews with the RCM and PSE analyst, and a written question and answer exchange with PSE.

The RCM Annual Report to PSE for this site provides a limited overview of RCM activities for the year, but the Facility Action Plan provides a more thorough description of actions taken by the RCM at each building in the portfolio. An on-site visit and interview with the RCMs responsible for the portfolio was also very enlightening regarding the overall project and specific actions taken. These particular RCMs are in a unique position as they are contracted through a large energy service company, with expertise knowledge of controls and commissioning that they can draw on. Also, there is a lot of high level district and on-site support for the program, which has allowed this project to be highly successful.

The RCM suggested another resource software accounting program he was familiar with might be a more robust tool for the RCM program than UM. The RCM also noted the grand agreement contract didn't clearly state PSE's expectations of the RCM which led to some confusion in the first year.

Findings regarding accuracy of claimed savings

As the RCM Program Start-up Incentive and claimed savings are simply based on a percentage of the baseline usage and the condition that certain criteria are met, there is no way to verify the accuracy of the claim. However, certain observations could be made about the year 1 salary guarantee and year 2 performance grant.

There were no incentivized ECM measures to subtract from the RCM savings for the Y1 salary guarantee analysis. A HDD baseline electric consumption adjustment was made for 3 schools having electric heat and a linear regression correlation greater than 70%, for a net decrease in savings of 71,012 kWh. Two more schools had a HDD linear regression correlation greater than 70%, which would have resulted in a savings loss, but they are gas heated so no adjustment was made. For one site in the portfolio the baseline and current usage in the analysis workbook do not match the values in the Utility Usage Savings Report and there is no documentation of the reason for the difference. For the Y2 performance grant analysis, there were 5 rebated ECM measures with a total savings of 289,590 kWh that was adjusted for in the savings analysis. Four sites were excluded from the claimed savings because they had an increase in usage, or "negative savings." Again, the HDD adjustment was applied to all schools with positive savings, electric heat, and a linear regression correlation greater than 70%, for an increase in claimed savings of 67,878 kWh. No gas heated sites had positive energy savings and a linear regression correlation greater than 70%, so the use of an adjustment is not known, but unlikely.

The methods used were consistent with PSE policy of eliminating negative savers and not applying HHD linear regression correlations to gas heated sites, however, these policies are questionable.

Recommendations

Project specific:

For the Y1 Salary Guarantee, adjust the annual savings by applying the HDD adjustment to all sites with a linear regression correlation greater than 70%, not just electric heat facilities. Also, fix the baseline and current usage for the non-matching site or provide a reason for the discrepancy.

For the Y2 Performance Grant, adjust the annual savings by including the "negative saving" sites and apply the HDD adjustment to all sites with a linear regression correlation greater than 70%.

Structural and systemic issues:

It is recommended that the policy of counting only sites which show positive savings is changed to sum adjusted savings for all sites in the portfolio, both positive and negative values – unless a particular site is excluded for extraordinary circumstances such as a remodeling or a change in use from the baseline year.

Rough engineering savings estimates should be developed for annual RCM energy-related activities by PSE engineers. This would provide a crosscheck with the Utility Manager data and could help inform UM processing, particularly the application of the Avoided Cost Module. Additionally, engineering savings estimates could identify RCM-achieved savings and avoided costs that were otherwise consumed by increased consumption due to activities beyond control of the RCM.

The utility manager was described and not very intuitive and difficult to use, with little training provided to the RCM on how to run the UM avoided cost module. Although PSE typically performs this task, a working knowledge of the program could help the RCMs track their progress better and report back to the facility. Also, they are still waiting for an upgrade to a web-based system that could simplify the UM analysis. Lastly, the RCM recommended that the UM be run on a meter bases, rather than rolling all of the meters for an account into a single analysis.

Savings Adjustment Methodology

Determining revised savings for the RCM program was a two-step process. First, total savings derived from each of the PSE savings analysis workbooks had to be proportioned to the claimed savings for each sampled measure. This was necessary because often the total savings for a given customer in a given year was split among multiple RCM measures, such as start-up incentive and salary guarantee. This first step was done using total savings as calculated by PSE; that is, negative savers were not included yet unless they had been included in PSE's original analysis. Then the revised savings for each sampled measure was the ratio of claimed measure savings to total PSE savings multiplied by the revised total savings, including all negative savers. The second step, calculating the stratum-weighted average savings reduction, applied a statistical method developed for California Public Utility Commission (CPUC) evaluations as documented in the California Evaluation Framework (TecMarket Works 2004).

The following outlines the calculation steps:

Step 1: Calculate the sample-based savings reduction using this equation:

$$b = \frac{\sum_{i=1}^{n} w_i y_i}{\sum_{i=1}^{n} w_i x_i}$$

Where:

b = the realization rate

wi = case weights, defined as the population count divided by the sample count for each stratum

yi = sample revised savings for case i

xi = sample claimed savings for case i

The savings reduction is 1-b.

Step 2: Calculate the standard error of b:

$$se(b) = \frac{\sqrt{\sum_{i=1}^{n} w_i (w_i - 1) e_i^{\,2}}}{\sum_{i=1}^{n} w_i x_i}$$

Where:

e = revised savings minus b times claimed savings

Step 3: Calculate the error bound at the 90% level of confidence of the realization rate, b, by multiplying the appropriate t-statistic (1.645) by the standard error of the realization rate, se(b). The upper and lower bound of the realization rate, b, were then calculated by adding and subtracting the 90% error bound from the realization rate.

$$CI = b +/- (1.645 \times se(b))$$

TecMarket Works. *California Evaluation Framework.* San Franciso: California Public Utilities Commission, 2004, 327-359.

Data Summaries

Table 44 and Table 45 below show details of claimed and review-adjusted savings for each analyzed customer facility, and aggregated to each sampled RCM project, respectively. The analytical approach described above was applied to these data sets to extrapolate the sample results to the RCM population.

Table 44: Claimed and review-adjusted RCM savings by customer facility

SBW Project ID	Measure Name	SBW Site ID	PSE Base Year Consumption (kWh)	PSE Current Year Consumption (kWh)	Adjustment Reason[1]	PSE Adjusted Base Year Consumption (kWh)	PSE ECM Claimed Savings	PSE Adjusted Savings Only (kWh) [<0 is positive savings]	3rd Party Review Revised Savings (kWh) [<0 is positive savings]
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 1	2,088,493	1,938,135	None	2,088,493		(150,358)	(150,358)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 2	1,217,690	1,075,971	HDD	1,200,566		(124,595)	(124,595)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 3	634,119	558,012	None	634,119		(76,107)	(76,107)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 4	692,346	628,969	None	692,346		(63,377)	(63,377)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 5	434,145	383,160	None	434,145		(50,985)	(50,985)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 6	1,936,501	1,887,573	None	1,936,501		(48,928)	(48,928)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 7	255,225	208,932	HDD	251,446		(42,514)	(42,514)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 8	339,037	294,069	HDD	333,311		(39,242)	(39,242)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 9	411,774	375,764	HDD	394,573		(18,809)	(18,809)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 10	251,814	226,003	None	251,814		(25,811)	(25,811)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 11	142,854	117,437	None	142,854		(25,417)	(25,417)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 12	207,350	182,122	HDD	202,973		(20,851)	(20,851)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 13	244,607	232,483	HDD	238,739		(6,256)	(6,256)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 14	599,283	591,630	HDD	583,409		-	8,221
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 15	489,402	483,004	HDD	485,237		(2,233)	(2,233)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 16	190,163	185,745	None	190,163		(4,418)	(4,418)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 17	455,509	452,000	None	455,509		(3,509)	(3,509)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 18	82,452	79,008	None	82,452		(3,444)	(3,444)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 19	121,425	118,576	HDD	117,754		-	822
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 20	62,993	62,799	None	62,993		(194)	(194)
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 21	1,713	2,080	None	1,713		-	367
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 22	104,593	105,424	HDD	102,176		-	3,248
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 23	239,531	241,194	None	239,531		-	1,663
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 24	98,873	102,139	HDD	95,468		-	6,671
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 25	1,056,677	1,061,373	HDD	1,027,401		-	33,972
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 26	122,183	129,481	None	122,183		-	7,298
774934 - School District A - Y1	RCM Salary Guarantee	774934 - School District A - Y1 - Site 27	300,961	312,350	HDD	297,655		-	14,695
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 1	1,887,573	1,725,460	None	1,887,573		(162,113)	(162,113)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 2	628,969	518,640	None	628,969		(110,329)	(110,329)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 3	591,630	498,524	HDD	539,374		(40,850)	(40,850)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 4	241,194	163,421	None	241,194		(77,773)	(77,773)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 5	383,160	327,473	None	383,160		(55,687)	(55,687)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 6	312,350	258,094	None	312,350		(54,256)	(54,256)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 7	558,012	522,600	None	558,012	16,031	(19,381)	(19,381)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 8	1,075,971	1,045,000	None	1,075,971		(30,971)	(30,971)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 9	208,932	178,917	None	208,932		(30,015)	(30,015)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 10	1,061,373	1,031,633	HDD	966,538	477	-	65,572
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 11	380,898	351,377	None	380,898		(29,521)	(29,521)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 12	483,004	457,598	None	483,004		(25,406)	(25,406)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 13	182,122	161,285	None	182,122		(20,837)	(20,837)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 14	232,483	216,003	None	232,483		(16,480)	(16,480)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 15	105,424	92,230	None	105,424		(13,194)	(13,194)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 16	102,139	92,415	HDD	91,722		-	693
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 17	226,003	219,232	None	226,003		(6,771)	(6,771)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 18	294,069	287,549	None	294,069		(6,520)	(6,520)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 19	117,437	113,890	None	117,437		(3,547)	(3,547)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 20	118,576	117,328	None	118,576		(1,248)	(1,248)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 21	2,080	1,496	None	2,080		(584)	(584)
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 22	62,799	64,028	None	62,799		-	1,229
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 23	79,008	81,395	None	79,008		-	2,387
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 24	185,745	192,498	None	185,745		-	6,753
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	774938 - School District A - Y2 - Site 25	1,938,135	1,960,239	None	1,938,135		-	22,104

783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 1	6,562,086	6,378,345	None	6,562,086		(183,741)	(183,741)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 2	224,920	165,229	None	224,920	21,394	(38,297)	(38,297)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 3	478,260	435,916	None	478,260		(42,344)	(42,344)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 4	307,886	271,680	HDD	285,155		(13,475)	(13,475)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 5	254,520	224,925	None	254,520		(29,595)	(29,595)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 6	136,320	119,384	HDD	127,480		(8,096)	(8,096)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 7	218,859	203,910	None	218,859	51,278	-	36,329
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 8	68,316	55,119	None	68,316		(13,197)	(13,197)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 9	95,783	86,690	None	95,783		(9,093)	(9,093)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 10	145,503	137,200	None	145,503	13,115	-	4,812
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 11	83,569	75,751	None	83,569		(7,818)	(7,818)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 12	67,275	60,011	None	67,275		(7,264)	(7,264)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 13	551,550	544,650	None	551,550		(6,900)	(6,900)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 14	21,995	15,235	None	21,995		(6,760)	(6,760)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 15	77,664	71,494	HDD	74,817		(3,323)	(3,323)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 16	26,500	20,608	None	26,500		(5,892)	(5,892)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 17	93,866	88,803	None	93,866		(5,063)	(5,063)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 18	14,472	10,110	None	14,472		(4,362)	(4,362)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 19	14,005	10,209	None	14,005		(3,796)	(3,796)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 20	12,854	9,157	None	12,854		(3,697)	(3,697)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 21	29,935	26,994	None	29,935		(2,941)	(2,941)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 22	48,565	45,937	None	48,565		(2,628)	(2,628)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 23	11,687	9,118	HDD	10,436		(1,318)	(1,318)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 24	152,594	150,049	None	152,594	1,360	(1,185)	(1,185)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 25	64,216	62,255	None	64,216		(1,961)	(1,961)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 26	7,955	6,390	None	7,955		(1,565)	(1,565)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 27	8,086	7,108	None	8,086		(978)	(978)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 28	46,307	45,368	None	46,307		(939)	(939)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 29	73,634	73,100	None	73,634		(534)	(534)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 30	10,722	10,501	None	10,722		(221)	(221)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 31	11,640	11,520	None	11,640		(120)	(120)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 32	3,183	3,082	HDD	2,977		-	105
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 33	12,605	12,534	None	12,605		(71)	(71)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 34	141,254	141,237	None	147,580		(6,343)	(6,343)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 35	105,611	106,088	HDD	92,243		-	13,845
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 36	2,054	2,788	HDD	1,956		-	832
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 37	12,077	12,889	None	12,077		-	812
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 38	22,197	23,020	None	22,197		-	823
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 39	12,176	13,063	CDD	14,179		(1,116)	(1,116)
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 40	13,650	14,620	HDD	13,007		-	1,613
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 41	10,116	11,747	None	10,116		-	1,631
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 42	661,826	664,002	None	661,826	2,993	-	5,169
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 43	422,216	424,652	None	422,216	3,414	-	5,850
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 44	94,485	97,453	None	94,485		-	2,968
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 45	52,566	55,783	None	52,566		-	3,217
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 46	27,305	31,035	None	27,305		-	3,730

783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 47	78,026	85,440	None	78,026		-	7,414
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 48	93,961	102,373	None	93,961		-	8,412
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 49	120,233	130,568	None	120,233		-	10,335
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 50	127,208	139,233	None	127,208		-	12,025
783483 - City A - Y1	RCM Salary Guarantee	783483 - City A - Y1 - Site 51	1,338,050	1,374,914	None	1,338,050		-	36,864
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 1	1,153,233	1,098,794	kG	1,197,137		(98,343)	(98,343)
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 2	315,528	298,863	None	315,528		(16,665)	(16,665)
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 3	39,185	34,055	None	39,185		(5,130)	(5,130)
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 4	17,169	14,455	HDD	16,219		(1,764)	(1,764)
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 5	14,669	12,703	None	14,669		(1,966)	(1,966)
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 6	4,057	2,787	None	4,057		(1,270)	(1,270)
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 7	7,819	7,262	IBY	7,819		(557)	(557)
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 8	13,482	13,258	HDD	12,698		-	560
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 9	3,768	3,640	None	3,768		(128)	(128)
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 10	8,467	8,718	HDD	8,040		-	678
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 11	37,995	38,857	None	37,995		-	862
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 12	16,962	18,697	None	16,962		-	1,735
843607 - City B - Y2	RCM Salary Guarantee	843607 - City B - Y2 - Site 13	34,250	37,366	None	34,250		-	3,116
777937 - College A - Y1	RCM Start-up Incentive	777937 - College A - Y1 - Site 1	15,987,530	14,408,020	None	15,987,098	83,333	(1,495,745)	(1,495,745)
777937 - College A - Y1	RCM Start-up Incentive	777937 - College A - Y1 - Site 2	343,574	307,882	HDD	335,378		(27,496)	(27,496)
777937 - College A - Y1	RCM Start-up Incentive	777937 - College A - Y1 - Site 3	63,206	62,040	HDD	61,931		109	109
777937 - College A - Y1	RCM Start-up Incentive	777937 - College A - Y1 - Site 4	2,987	4,307	None	2,987		1,320	1,320
804567 - College B - Y1	RCM Start-up Incentive	804567 - College B - Y1 - Site 1	10,545,650	10,055,048	None	10,545,650	148,091	(342,511)	(342,511)
804567 - College B - Y1	RCM Start-up Incentive	804567 - College B - Y1 - Site 2	430,564	439,599	None	430,564	-	-	9,035
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 1	820,401	700,577	HDD	806,963		(106,386)	(106,386)
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 2	245,950	152,005	None	245,950		(93,945)	(93,945)
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 3	1,082,963	1,038,444	None	1,082,963		(44,519)	(44,519)
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 4	747,421	715,350	None	747,421		(32,071)	(32,071)
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 5	239,452	229,820	None	239,452		-	(9,632)
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 6	296,516	289,509	None	296,516		(7,007)	(7,007)
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 7	596,031	596,975	None	596,031		-	944
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 8	572,236	600,302	None	572,236		-	28,066
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 9	155,309	187,576	None	155,309		-	32,267
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 10	373,220	416,644	None	373,220		-	43,424
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 11	719,019	797,443	None	719,019		-	78,424
747054 - School District B - Y3	RCM Salary Guarantee	747054 - School District B - Y3 - Site 12	1,543,548	1,630,306	HDD	1,504,792		-	125,514
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 1	1,990,260	1,270,067	HDD	1,822,519		(552,452)	(552,452)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 2	2,282,374	2,037,445	HDD	2,189,424		(151,979)	(151,979)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 3	1,676,165	1,520,116	HDD	1,594,523		(74,407)	(74,407)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 4	745,909	595,435	HDD	721,323		(125,888)	(125,888)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 5	993,315	860,069	HDD	959,538		(99,469)	(99,469)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 6	662,263	542,369	HDD	634,339		(91,970)	(91,970)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 7	2,095,493	1,978,047	None	2,095,493		(117,446)	(117,446)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 8	1,004,902	895,672	HDD	957,833	56,509	(5,652)	(5,652)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 9	693,318	585,556	None	693,318		(107,762)	(107,762)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 10	802,777	698,990	HDD	783,103		(84,113)	(84,113)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 11	639,054	544,739	HDD	610,858		(66,119)	(66,119)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 12	665,402	578,446	HDD	639,102		(60,656)	(60,656)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 13	707,146	628,915	HDD	686,891		(57,976)	(57,976)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 14	3,300,662	3,224,740	HDD	3,188,905		-	35,835

773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 15	929,191	865,161	HDD	887,552		(22,391)	(22,391)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 16	715,920	654,207	None	715,920		(61,713)	(61,713)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 17	485,433	426,161	HDD	477,521		(51,360)	(51,360)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 18	523,971	464,720	HDD	506,489		(41,769)	(41,769)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 19	491,641	432,911	None	491,641		(58,730)	(58,730)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 20	626,761	574,107	HDD	603,179		(29,072)	(29,072)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 21	177,930	126,091	HDD	174,523		(48,432)	(48,432)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 22	439,266	388,114	HDD	417,242		(29,128)	(29,128)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 23	538,094	491,886	HDD	515,803		(23,917)	(23,917)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 24	583,927	537,857	HDD	568,639		(30,782)	(30,782)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 25	394,409	350,468	HDD	392,559		(42,091)	(42,091)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 26	598,733	557,803	HDD	580,097		(22,294)	(22,294)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 27	434,881	404,557	HDD	419,789		(15,232)	(15,232)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 28	714,256	684,828	None	714,256		(29,428)	(29,428)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 29	271,384	246,427	None	271,384		(24,957)	(24,957)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 30	348,612	328,997	HDD	334,927		(5,930)	(5,930)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 31	418,093	402,484	None	418,093		(15,609)	(15,609)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 32	587,683	572,592	None	587,683		(15,091)	(15,091)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 33	471,421	458,102	HDD	450,490		-	7,612
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 34	269,664	259,699	HDD	254,109		-	5,590
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 35	412,289	403,006	HDD	394,626		-	8,380
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 36	709,897	705,645	HDD	681,066		-	24,579
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 37	367,188	363,684	HDD	347,961		-	15,723
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 38	58,885	55,527	HDD	58,288		(2,761)	(2,761)
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 39	15,740	16,110	None	15,740		-	370
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 40	211,221	212,710	None	212,710		-	-
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 41	344,092	348,604	HDD	329,985		-	18,619
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 42	275,492	281,176	HDD	263,827		-	17,349
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 43	220,220	242,300	None	220,220		-	22,080
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 44	612,972	637,529	HDD	591,480		-	46,049
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 45	309,131	340,866	HDD	298,783		-	42,083
773881 - School District C - RY1	RCM Renewal Perform Incentive	773881 - School District C - RY1 - Site 46	392,089	426,371	HDD	372,880		-	53,491
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 1	2,191,156	1,902,192	HDD + Solar	2,155,789		(253,597)	(253,597)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 2	839,306	570,260	HDD	811,950		(241,690)	(241,690)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 3	1,807,843	1,560,915	Solar	1,797,843	57,527	(179,401)	(179,401)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 4	759,707	520,912	HDD	730,354		(209,442)	(209,442)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 5	1,384,153	1,193,425	HDD + Solar	1,325,137		(131,712)	(131,712)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 6	776,985	590,488	HDD	745,875	10,644	(144,743)	(144,743)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 7	1,881,136	1,723,323	None	1,881,136	8,870	(148,943)	(148,943)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 8	1,360,989	1,206,991	HDD	1,317,800	18,972	(91,837)	(91,837)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 9	439,021	296,290	None	439,021		(142,731)	(142,731)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 10	884,685	758,290	None	884,685	18,717	(107,678)	(107,678)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 11	702,619	576,832	None	702,619		(125,787)	(125,787)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 12	714,996	594,230	HDD	690,358		(96,128)	(96,128)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 13	474,372	358,308	None	474,372	78,061	(38,003)	(38,003)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 14	853,574	759,438	None	853,574		(94,136)	(94,136)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 15	951,861	858,887	None	951,861		(92,974)	(92,974)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 16	747,266	664,150	HDD	719,786		(55,636)	(55,636)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 17	1,109,849	1,029,892	None	1,109,849		(79,957)	(79,957)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 18	723,245	649,524	None	723,245		(73,721)	(73,721)

772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 19	437,602	368,959	None	437,602		(68,643)	(68,643)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 20	445,840	381,240	None	445,840		(64,600)	(64,600)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 21	461,910	404,156	None	461,910		(57,754)	(57,754)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 22	311,861	258,855	None	311,861		(53,006)	(53,006)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 23	421,028	368,100	None	421,028		(52,928)	(52,928)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 24	449,971	397,680	None	449,971		(52,291)	(52,291)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 25	400,706	351,270	None	400,706		(49,436)	(49,436)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 26	482,484	434,029	None	482,484		(48,455)	(48,455)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 27	515,541	471,651	None	515,541		(43,890)	(43,890)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 28	505,348	462,188	HDD	490,435	10,644	(17,603)	(17,603)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 29	426,721	383,884	None	426,721		(42,837)	(42,837)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 30	954,883	917,068	None	954,883		(37,815)	(37,815)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 31	317,176	280,431	None	317,176		(36,745)	(36,745)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 32	335,192	299,274	None	335,192	547	(35,371)	(35,371)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 33	379,086	349,892	None	379,086		(29,194)	(29,194)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 34	388,571	360,897	None	376,763		(15,866)	(15,866)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 35	402,266	382,348	None	402,266	14,192	(5,726)	(5,726)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 36	472,132	452,456	None	472,132		(19,676)	(19,676)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 37	342,536	323,442	None	342,536		(19,094)	(19,094)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 38	363,793	350,264	None	363,793		(13,529)	(13,529)
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 39	337,248	342,498	None	337,248		(5,250)	5,250
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	772063 - School District D - RY3 - Site 40	1,736,031	1,798,257	Sq Ft	1,736,031		(62,226)	62,226
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 1	2,174,031	2,002,322	None	2,174,031		(171,709)	(171,709)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 2	1,198,345	1,072,759	None	1,198,345		(125,586)	(125,586)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 3	1,036,593	945,062	HDD	1,061,937		(116,875)	(116,875)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 4	850,310	805,767	HDD	903,035		(97,268)	(97,268)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 5	854,543	822,569	None	854,543		(31,974)	(31,974)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 6	235,692	208,292	None	235,692		(27,400)	(27,400)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 7	338,772	312,401	None	338,772		(26,371)	(26,371)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 8	898,104	874,249	None	898,104		(23,855)	(23,855)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 9	365,760	343,163	None	365,760		(22,597)	(22,597)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 10	305,296	297,468	None	305,296		(7,828)	(7,828)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 11	734,858	727,283	HDD	777,121		(49,838)	(49,838)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 12	478,654	473,300	HDD	504,730		(31,430)	(31,430)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 13	326,390	322,002	None	326,390		(4,388)	(4,388)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 14	442,574	441,600	None	449,305		(7,705)	(7,705)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 15	20,409	20,426	HDD	22,359		(1,933)	(1,933)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 16	373,687	374,585	None	373,687		898	898
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 17	579,745	585,207	HDD	614,964		(29,757)	(29,757)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 18	476,342	487,617	HDD	503,058		(15,441)	(15,441)
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 19	964,870	985,531	None	964,870		-	20,661
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 20	349,329	385,809	None	349,329		-	36,480
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 21	305,247	342,898	None	305,247		-	37,651
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	825833 - School District E - RY1 - Site 22	2,397,274	2,577,940	HDD	2,520,278		-	57,662
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 1	344,745	349,800	None	344,745	47,077		52,132
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 2	259,603	214,080	None	259,603	47,077		1,554
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 3	2,574,401	2,074,048	HDD	2,539,798	46,147	(419,603)	(419,603)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 4	632,276	556,159	HDD	616,525	50,177	(10,189)	(10,189)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 5	712,156	630,560	HDD	695,915	39,637	(25,718)	(25,718)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 6	441,680	403,884	None	441,680	48,627		10,831

827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 7	601,048	604,671	None	601,048	37,777		41,400
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 8	356,145	300,240	None	356,145	40,877	(15,028)	(15,028)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 9	425,570	387,963	HDD	417,058	37,777		8,682
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 10	193,884	183,680	None	193,884	39,327		29,123
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 11	572,634	469,480	None	572,634	43,202	(59,952)	(59,952)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 12	497,203	474,631	HDD	486,798	40,877		28,710
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 13	668,492	569,834	HDD	647,153	40,257	(37,062)	(37,062)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 14	1,952,938	1,850,339	None	1,952,938	51,727	(50,872)	(50,872)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 15	453,918	412,964	None	453,918	40,877	(77)	(77)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 16	629,361	560,880	None	629,361	37,777	(30,704)	(30,704)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 17	5,127	5,450	None	5,127	-		323
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 18	755,729	669,600	HDD	734,362	37,777	(26,985)	(26,985)
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	827162 - School District F - RY3 - Site 19	721,129	724,582	HDD	721,129	39,327		42,780
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 1	1,731,345	1,535,897	AMT	1,740,293	87,528	(116,868)	(116,868)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 2	1,251,104	1,100,192	AMT	1,265,118	386,721	-	221,795
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 3	1,802,607	1,670,979	AMT	1,820,905	49,391	(100,535)	(100,535)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 4	2,110,488	1,993,935	AMT	2,098,428	230,502	-	126,009
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 5	1,703,826	1,609,821	AMT	1,724,713	89,066	(25,826)	(25,826)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 6	1,363,845	1,287,193	AMT	1,374,073	66,588	(20,292)	(20,292)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 7	1,552,366	1,493,941	AMT	1,564,763	19,478	(51,344)	(51,344)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 8	1,701,476	1,644,617	AMT	1,706,781	65,886	-	3,722
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 9	1,781,886	1,728,191	AMT	1,802,943	189,602	-	114,850
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 10	1,319,387	1,265,756	AMT	1,324,942	59,204	-	18
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 11	1,914,369	1,862,061	AMT	1,930,700	117,382	-	48,743
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 12	1,382,985	1,339,548	AMT	1,397,250	12,253	(45,449)	(45,449)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 13	1,347,424	1,305,780	AMT	1,331,917	20,172	(5,965)	(5,965)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 14	1,303,682	1,264,125	AMT	1,315,989	57,995	-	6,131
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 15	1,631,884	1,597,354	AMT	1,645,164	54,956	-	7,146
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 16	1,439,068	1,407,928	AMT	1,455,717	44,659	(3,130)	(3,130)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 17	1,627,660	1,597,739	AMT	1,642,504	19,145	(25,620)	(25,620)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 18	1,850,775	1,821,750	AMT	1,876,644	185,231	-	130,337
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 19	1,570,087	1,542,745	AMT	1,595,603	25,153	(27,705)	(27,705)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 20	2,271,818	2,253,914	AMT	2,291,231	36,594	(723)	(723)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 21	1,493,351	1,477,165	AMT	1,485,772	48,039	-	39,432
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 22	1,261,045	1,246,350	AMT	1,276,901	20,708	(9,843)	(9,843)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 23	735,000	721,210	AMT	739,153	-	(17,943)	(17,943)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 24	2,582,394	2,570,028	AMT	2,607,774	90,028	-	52,282
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 25	1,437,261	1,425,160	AMT	1,450,575	84,467	-	59,052
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 26	2,117,512	2,105,979	AMT	2,136,838	16,040	(14,819)	(14,819)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 27	1,288,102	1,279,056	AMT	1,296,513	-	(17,457)	(17,457)
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 28	1,109,467	1,101,648	AMT	1,119,570	20,782	-	2,860
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 29	662,567	655,963	AMT	664,368	30,861	-	22,456
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 30	1,605,894	1,600,118	AMT	1,621,419	42,259	-	20,958
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 31	1,656,189	1,652,452	AMT	1,645,858	34,704	-	41,298
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 32	1,383,492	1,411,192	AMT	1,394,992	8,380	-	24,580
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 33	1,604,594	1,649,365	AMT	1,618,986	20,151	-	50,530
841408 - Grocery A - Y4	RCM Salary Guarantee	841408 - Grocery A - Y4 - Site 34	1,433,290	1,655,337	AMT	1,449,486	45,060	-	250,911
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 1	1,403,007	1,362,720	None	1,403,007		(40,287)	(40,287)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 2	1,688,528	1,668,240	None	1,688,528		(20,288)	(20,288)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 3	52,483	35,520	Sq Ft	46,263		(10,743)	(10,743)

814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 4	63,103	48,524	OCC	55,813		(7,289)	(7,289)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 5	73,134	60,449	None	73,134		(12,685)	(12,685)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 6	160,462	148,158	None	160,462		(12,304)	(12,304)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 7	92,447	80,989	HDD	90,756		(9,767)	(9,767)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 8	52,994	44,280	None	52,994		(8,714)	(8,714)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 9	47,757	41,240	None	47,757		(6,517)	(6,517)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 10	70,320	64,528	None	70,320		(5,792)	(5,792)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 11	97,529	91,990	HDD	95,175		(3,185)	(3,185)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 12	48,510	43,153	None	48,510		(5,357)	(5,357)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 13	15,368	11,031	None	15,368		(4,337)	(4,337)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 14	55,232	51,360	None	55,232		(3,872)	(3,872)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 15	60,259	56,676	None	60,259		(3,583)	(3,583)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 16	29,345	25,875	None	29,345		(3,470)	(3,470)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 17	37,670	34,226	HDD	36,382		(2,156)	(2,156)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 18	13,873	10,940	HDD	13,167		(2,227)	(2,227)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 19	19,867	17,216	None	19,867		(2,651)	(2,651)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 20	28,944	27,364	HDD	28,662		(1,298)	(1,298)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 21	13,589	12,322	None	13,589		(1,267)	(1,267)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 22	8,596	7,629	None	8,596		(967)	(967)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 23	6,085	5,341	HDD	6,009		(668)	(668)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 24	103,873	103,508	None	103,873		(365)	(365)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 25	6,235	6,213	None	6,235		(22)	(22)
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 26	465,250	465,324	HDD	460,095		-	5,229
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 27	57,862	58,280	ECM	57,862	937	-	1,355
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 28	6,013	6,551	HDD	5,881		-	670
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 29	35,085	36,469	None	35,085		-	1,384
814019 - County A - Y1	RCM Salary Guarantee	814019 - County A - Y1 - Site 30	76,104	82,724	HDD	73,235		-	9,489
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 1	1,668,240	1,395,778	None	1,668,240		(272,462)	(272,462)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 2	114,604	80,581	OCC	83,153		(2,572)	(2,572)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 3	1,362,720	1,329,311	None	1,362,720		(33,409)	(33,409)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 4	465,324	432,355	HDD	455,696		(23,341)	(23,341)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 5	82,724	52,320	HDD	79,201		(26,881)	(26,881)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 6	44,280	26,675	None	44,280		(17,605)	(17,605)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 7	35,520	20,925	None	35,520		(14,595)	(14,595)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 8	148,158	134,210	None	148,158		(13,948)	(13,948)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 9	48,524	38,302	OCC	41,670		(3,368)	(3,368)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 10	51,360	41,714	None	51,360		(9,646)	(9,646)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 11	41,240	33,761	None	41,240		(7,479)	(7,479)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 12	19,641	12,767	None	19,641		(6,874)	(6,874)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 13	103,508	97,974	None	103,508		(5,534)	(5,534)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 14	27,364	23,621	HDD	26,702		(3,081)	(3,081)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 15	36,469	32,853	None	36,469		(3,616)	(3,616)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 16	28,386	25,760	None	28,386		(2,626)	(2,626)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 17	64,528	61,942	None	64,528		(2,586)	(2,586)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 18	11,031	8,530	None	11,031		(2,501)	(2,501)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 19	9,904	8,331	None	9,904		(1,573)	(1,573)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 20	65,001	63,669	HDD	63,028		-	641
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 21	6,213	6,015	HDD	6,040		(25)	(25)
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 22	7,629	7,670	None	7,629		-	41
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 23	12,322	12,466	HDD	12,077		-	389

843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 24	43,153	43,360	None	43,153		-	207
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 25	60,449	61,270	None	60,449		-	821
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 26	25,875	26,787	None	25,875		-	912
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 27	10,940	12,028	HDD	10,087		-	1,941
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 28	80,989	82,246	HDD	78,522		-	3,724
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 29	17,216	18,654	None	17,216		-	1,438
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 30	56,676	58,894	None	56,676		-	2,218
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 31	58,280	60,575	ECM	58,280	1,872	-	4,167
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 32	2,787	5,343	None	2,787		-	2,556
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 33	5,341	8,001	None	5,341		-	2,660
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 34	34,226	38,252	HDD	30,602		-	7,650
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 35	91,990	98,118	HDD	88,941		-	9,177
843604 - County A - Y2	RCM Salary Guarantee	843604 - County A - Y2 - Site 36	196,660	214,695	None	196,660		-	18,035
800479 - School District G - Y1	RCM Start-up Incentive	800479 - School District G - Y1 - Site 1	1,561,984	1,223,576	None	1,561,984		(338,408)	(338,408)
800479 - School District G - Y1	RCM Start-up Incentive	800479 - School District G - Y1 - Site 2	2,485,189	2,194,439	None	2,485,189		(290,750)	(290,750)
800479 - School District G - Y1	RCM Start-up Incentive	800479 - School District G - Y1 - Site 3	1,094,706	830,151	HDD	1,060,113	-	(229,962)	(229,962)
800479 - School District G - Y1	RCM Start-up Incentive	800479 - School District G - Y1 - Site 4	1,155,663	910,668	HDD	1,114,916		(204,248)	(204,248)
800479 - School District G - Y1	RCM Start-up Incentive	800479 - School District G - Y1 - Site 5	588,035	491,900	None	588,035		(96,135)	(96,135)
800479 - School District G - Y1	RCM Start-up Incentive	800479 - School District G - Y1 - Site 6	815,498	723,269	None	815,498	-	(92,229)	(92,229)
800479 - School District G - Y1	RCM Start-up Incentive	800479 - School District G - Y1 - Site 7	1,225,442	1,135,334	None	1,225,442		(90,107)	(90,107)
800479 - School District G - Y1	RCM Start-up Incentive	800479 - School District G - Y1 - Site 8	358,997	314,523	HDD	343,324		(28,801)	(28,801)
800479 - School District G - Y1	RCM Start-up Incentive	800479 - School District G - Y1 - Site 9	637,949	609,273	None	637,949	-	(28,676)	(28,676)
772112 - Office A - Y2	RCM Yr 2 Perform Incentive	772112 - Office A - Y2 - Site 1	1,889,130	1,369,150	OCC	1,568,360		(199,210)	(199,210)
772112 - Office A - Y2	RCM Yr 2 Perform Incentive	772112 - Office A - Y2 - Site 2	1,851,634	1,598,506	None	1,851,634		(253,128)	(253,128)
772112 - Office A - Y2	RCM Yr 2 Perform Incentive	772112 - Office A - Y2 - Site 3	1,785,067	1,656,720	None	1,785,067		(128,347)	(128,347)
772112 - Office A - Y2	RCM Yr 2 Perform Incentive	772112 - Office A - Y2 - Site 4	1,479,890	1,385,388	HDD	1,446,085		(60,697)	(60,697)
772112 - Office A - Y2	RCM Yr 2 Perform Incentive	772112 - Office A - Y2 - Site 5	2,747,996	2,746,937	None	2,747,996		(1,059)	(1,059)
772112 - Office A - Y2	RCM Yr 2 Perform Incentive	772112 - Office A - Y2 - Site 6	3,247,456	3,250,717	None	3,247,456		-	3,261
772112 - Office A - Y2	RCM Yr 2 Perform Incentive	772112 - Office A - Y2 - Site 7	863,216	1,047,261	OCC	894,274		-	152,987
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 6	1,563,627	1,479,890	None	1,563,627		(83,737)	(83,737)
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 4	1,523,574	863,216	OCC	950,902		(87,686)	(87,686)
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 5	2,221,266	1,889,128	None	2,221,266		(332,138)	(332,138)
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 16	2,443,936	2,747,995	None	2,443,936		-	304,059
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 7	1,787,732	1,785,068	None	1,787,732		(2,664)	(2,664)
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 15	2,985,648	3,247,457	None	2,985,648		-	261,809
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 2	3,861,350	335,155	CDD + OCC	361,570		(26,415)	(26,415)
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 1	1,208,330	120,189	CDD + OCC	106,354		-	13,835
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 14	1,702,982	1,851,634	HDD + OCC	1,870,477		(18,843)	(18,843)
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 9	316,821	348,588	None	316,821		-	31,767
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 10	465,067	539,694	None	465,067		-	74,627
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 11	592,260	677,075	None	592,260		-	84,815
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 12	604,655	702,075	None	604,655		-	97,420
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 8	626,226	654,110	None	626,226		-	27,884
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 13	1,183,900	1,327,924	HDD	1,173,619		-	154,305
772109 - Office A - Y1	RCM Salary Guarantee	772109 - Office A - Y1 - Site 3	2,470,125	1,769,986	HDD	2,462,713	34,585	(658,142)	(658,142)
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 1	796,701	748,295	None	796,701		(48,406)	(48,406)
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 2	443,983	415,622	None	443,983		(28,361)	(28,361)
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 3	145,073	128,116	None	145,073		(16,957)	(16,957)
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 4	521,859	506,952	None	521,859		(14,907)	(14,907)
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 5	227,528	215,628	None	227,528		(11,900)	(11,900)

792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 6	536,710	527,619	None	536,710		(9,091)	(9,091)
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 7	147,832	138,861	None	147,832		(8,971)	(8,971)
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 8	370	400	None	370		-	30
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 9	509	550	None	509		-	41
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 10	492,314	493,461	None	492,314		-	1,147
792160 - College C - Y1	RCM Salary Guarantee	792160 - College C - Y1 - Site 11	148,968	154,039	None	148,968		-	5,071
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 1	1,408,792	1,361,336	None	1,408,792		(47,456)	(47,456)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 2	299,756	260,057	HDD	292,513	146,359	-	113,903
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 3	40,813	25,586	HDD	37,977		(12,391)	(12,391)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 4	42,516	27,628	HDD	39,259		(11,631)	(11,631)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 5	122,602	111,435	None	122,602		(11,167)	(11,167)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 6	28,325	18,376	None	28,325		(9,949)	(9,949)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 7	14,359	5,476	None	14,359		(8,883)	(8,883)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 8	11,064	5,690	None	11,064		(5,374)	(5,374)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 9	46,468	41,654	HDD	42,977		(1,323)	(1,323)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 10	30,378	26,452	HDD	29,346		(2,894)	(2,894)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 11	43,004	39,117	None	43,004		(3,887)	(3,887)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 12	35,440	32,313	HDD	33,838		(1,525)	(1,525)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 13	10,820	8,670	HDD	10,556		(1,886)	(1,886)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 14	78,728	76,613	HDD	75,471		-	1,142
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 15	157,444	155,520	HDD	148,472		-	7,048
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 16	20,783	18,987	HDD	20,339		(1,352)	(1,352)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 17	18,743	17,011	HDD	18,915		(1,904)	(1,904)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 18	15,309	13,727	None	15,309		(1,582)	(1,582)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 19	139,305	137,756	HDD	130,884		-	6,872
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 20	16,742	15,285	HDD	14,858		-	427
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 21	14,097	12,642	None	14,097		(1,455)	(1,455)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 22	7,852	6,564	None	7,852		(1,288)	(1,288)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 23	48,057	46,851	HDD	45,596		-	1,255
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 24	5,296	4,356	None	5,296		(940)	(940)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 25	106,544	105,620	HDD	100,312		-	5,308
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 26	19,392	18,591	None	19,392		(801)	(801)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 27	17,468	16,713	None	17,468		(755)	(755)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 28	1,617	1,223	None	1,617		(394)	(394)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 29	5,320	4,960	None	5,320		(360)	(360)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 30	13,230	12,921	None	13,230		(309)	(309)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 31	3,272	2,965	None	3,272		(307)	(307)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 32	200	159	None	200		(41)	(41)
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 33	353,548	354,077	HDD	342,809		-	11,268
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 34	53,921	54,973	None	53,921		-	1,052
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 35	6,299	9,449	hdd	6,187		-	3,262
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 36	527,812	534,991	None	527,812		-	7,179
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 37	13,002	21,213	None	13,002		-	8,211
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 38	146,654	160,585	None	146,654		-	13,931
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	751032 - County B - Y3 - Site 39	2,170,200	2,202,462	None	2,170,200		-	32,262

Notes

1 Adjustments to base year consumption made based on correlations with the following: HDD=Heating Degree Days, CDD=Cooling Degree Days, OCC=Occupancy, IBY=Incomplete Base Year, AMT=Average Monthly Temperature, kG=Thousands of Gallons Treated.

Table 45: Claimed and review-adjusted RCM project savings

SBW ID	PSE Measure Name	PSE Measure Paid Date	PSE Claimed Savings (kWh)	Total "Adjusted Savings" from PSE Savings Analysis workbooks (kWh)	Proportion of Total "Adjusted Savings" Claimed for Measure	Total Revised Savings from 3rd Party Review Analysis (kWh)	Revised Savings Proportionate to Measure (kWh)	Stratum	Realization Rate	Notes
774934 - School District A - Y1	RCM Salary Guarantee	02/13/10	445,861	707,048	0.63	630,091	397,332	2	0.89	1
774938 - School District A - Y2	RCM Yr 2 Perform Incentive	12/08/10	597,032	705,483	0.85	606,745	513,473	2	0.86	2
783483 - City A - Y1	RCM Salary Guarantee	10/05/10	146,004	414,633	0.35	257,847	90,795	1	0.62	3
843607 - City B - Y2	RCM Salary Guarantee	02/02/11	125,823	125,823	1.00	118,872	118,872	1	0.94	
777937 - College A - Y1	RCM Start-up Incentive	12/02/10	1,405,312	1,521,812	0.92	1,521,812	1,405,312	9	1.00	4
804567 - College B - Y1	RCM Start-up Incentive	06/01/11	151,411	342,511	0.44	333,476	147,417	1	0.97	5
804570 - College B - Y1	RCM Salary Guarantee	06/03/11	191,100		0.56		186,059	1	0.97	5
747054 - School District B - Y3	RCM Salary Guarantee	10/28/10	283,928	283,928	1.00	(15,079)	(15,079)	1	(0.05)	
773881 - School District C - RY1	RCM Renewal Perform Incentive	07/27/10	2,022,102	2,166,576	0.93	1,868,816	1,744,198	9	0.86	6
772063 - School District D - RY3	RCM Yr 3 Perform Incentive	12/15/10	2,790,114	3,140,051	0.89	3,005,099	2,670,201	9	0.96	7
825833 - School District E - RY1	RCM Salary Guarantee Yr 1 Renewal	06/05/10	711,667	791,057	0.90	638,603	574,513	2	0.81	8
827162 - School District F - RY3	RCM Yr 3 Perform Incentive	03/21/11	596,701	676,190	0.88	460,655	406,503	2	0.68	9
841408 - Grocery A - Y4	RCM Salary Guarantee	01/04/11	483,519	483,519	1.00	(739,591)	(739,591)	2	(1.53)	10
814019 - County A - Y1	RCM Salary Guarantee	03/04/10	161,854	169,811	0.95	151,684	144,576	1	0.89	11
843604 - County A - Y2	RCM Salary Guarantee	02/02/11	453,722	453,722	1.00	397,145	397,145	2	0.88	
800479 - School District G - Y1	RCM Start-up Incentive	06/17/11	140,412	1,399,316	0.10	1,399,316	140,412	1	1.00	12
772112 - Office A - Y2	RCM Yr 2 Perform Incentive	11/10/10	642,441	642,441	1.00	486,193	486,193	2	0.76	
772109 - Office A - Y1	RCM Salary Guarantee	01/06/10	620,966	1,209,625	0.51	159,104	81,677	2	0.13	13
792160 - College C - Y1	RCM Salary Guarantee	12/09/10	138,593	138,593	1.00	132,304	132,304	1	0.95	
751032 - County B - Y3	RCM Software Maint Agmt Yr 3	09/17/10	45,489	129,854						14

Notes

1 Remainder between Total Adjusted and Claimed is claimed under software and start-up incentive measures.

2 Remainder between Total Adjusted and Claimed is claimed under software measure.

3 PSE analyst verified mistake in claim for this measure and it has been corrected here. Remainder between Total Adjusted and Claimed is claimed under start-up incentive measure. The revised savings is significantly impacted by ECMs which made savings at two facilities go from positive to negative*.

4 Could not find explanation for difference between total from savings analysis workbook and claim.

5 Claimed savings from two sampled measures for this customer adds to total of savings from all facilities for this contract year.

6 Remainder between Total Adjusted and Claimed is claimed under software measure.

7 Remainder between Total Adjusted and Claimed is claimed under software measure. There were two facilities that reported negative savings as positive. The revised savings reflects that correction.

8 Remainder between Total Adjusted and Claimed is claimed under software measure.

9 Remainder between Total Adjusted and Claimed is claimed under software and training measures. The revised savings is significantly impacted by ECMs which made savings at five facilities go from positive to negative*.

10 Revised savings is significantly impacted by ECMs which made savings at 16 facilities go from positive to negative*.

11 Claimed savings left off last two sites in PSE savings analysis workbook. Footnotes mention 50% reduction at Site 4 and Site 23 but numbers still do not add up.

12 Remainder between Total Adjusted and Claimed is claimed under salary guarantee measure.

13 Remainder between Total Adjusted and Claimed is claimed under software and start-up incentive measures.

14 Remainder between Total Adjusted and Claimed is to be claimed under Y3 true-up claim. This sampled measure was excluded from the revised savings analysis since the claim was for a software measure. Software savings are determined in the grant calculations which are independent from billing analysis. However, note that the total savings for this customer swung significantly from positive to negative, primarily due to a large ECM savings reduction at one site*.

* The facilities where the ECM savings reductions cause facility-level savings to go from positive to negative indicate that the savings credited to the ECM may not have been realized.