EXHIBIT NO. ___(RWS-12)
DOCKET NOS. UE-111048/UG-111049
2011 PSE GENERAL RATE CASE
WITNESS: ROBERT W. STOLARSKI

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PUGET SOUND ENERGY, INC.,** **Respondent.**	**Docket No. UE-111048** **Docket No. UG-111049**

ELEVENTH EXHIBIT (NONCONFIDENTIAL) TO THE PREFILED REBUTTAL TESTIMONY OF ROBERT W. STOLARSKI ON BEHALF OF PUGET SOUND ENERGY, INC.

JANUARY 17, 2012

Report by **SBW CONSULTING, INC.**

Report No. **1104**

FIRST INTERIM REPORT

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

Submitted to
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December 21, 2011

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KEMA

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Introduction

The Washington Utilities and Transportation Commission issued an order in 2010 adopting a settlement agreement between Puget Sound Energy and various stakeholder parties. The settlement included conditions 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 conditions mandates an independent third-party review of the electric energy savings reported by PSE for the 2010-2011 biennium. This report is the first of several to be developed as part of this third-party review, and specifically addresses PSE's 2010 electric savings claim.

Objectives

The primary purpose of this review is to assess the extent to which the electric energy savings that PSE reported for their entire 2010-11 electric conservation portfolio were achieved. This report is the first of three interim reports, which assess portfolio accomplishments for all of 2010, the first half of 2011, and all of 2011, respectively. In April 2012, a final report will be issued that integrates and synthesizes these interim reports, and thereby addresses portfolio accomplishments for the entire 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 Gross Savings Review. 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.
- 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.

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 Gross 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 next performed a high-level portfolio review by reconciling the figures in the 2010 Annual Report with supporting data. Simultaneously, the team began a systematic and comprehensive examination of 297 individual project files to compare their 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.

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 gross 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, which included invoices, manufacturer's cut sheets, photos, inspection reports, and sampling procedures, etc., and assessed whether it was adequate.

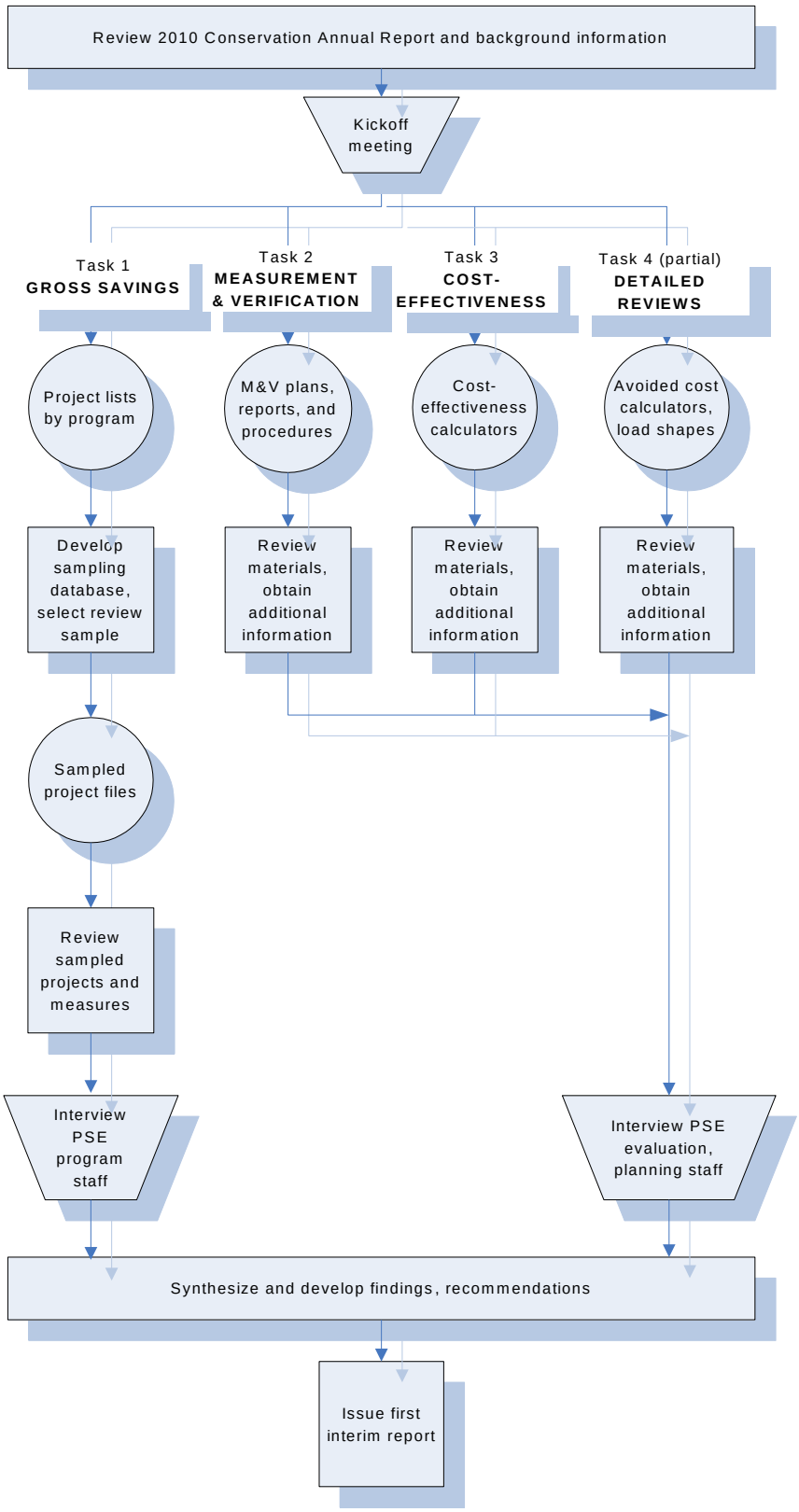


Figure E-1: Overview of Third-party Review.

- *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 annual conservation report 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 TRC using Northwest Pacific Power and Conservation Council (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. During the review 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 6th 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 Gross Savings Review. Our comparison of reported savings to program tracking database savings found that program-specific values matched across the board, with one exception. This discrepancy resulted because PSE discovered double-counted items in a single-family residential lighting program (E214). The tracking database we received did not account for this, but more importantly, the revised 2010 annual report did.

After examining the files and supporting information for the 297 sampled projects, and engaging in follow-up data requests and discussions with PSE program staff, the review team was generally satisfied with the documentation and explanations they were given regarding the claimed savings for the sampled projects. Overall, it appears that PSE has done a credible job of tracking and reporting program accomplishments for the 2010 electric efficiency portfolio. That said, two of the programs—Single Family New Construction (E215) and RCM (Resource Conservation Manager) (E253)—could benefit from more detailed study as part of the next steps in the portfolio review, largely because their size and complexity prevented a complete review at this juncture.

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.

- ***Measure installation verification***

  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: (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 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 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.

- ***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. 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

Overall, the review team has confirmed the veracity of PSE's 2010 portfolio savings claim. While there are particular areas where we would like to investigate further, we did not find any major problems with the numbers and the underlying documentation of the sampled projects that we reviewed. The team also 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, and developed recommendations for addressing these areas. While many of these recommendations have been apparent to PSE for some time, they are listed 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.

General recommendations

1. **Develop consistent and complete program tracking databases**

   PSE database activity occurs over a patchwork of systems. Some of these databases are partially documented. As 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 varied across programs. 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. The review team's 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[1].

2. **Carefully document how to use 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 that a 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 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 continue its process of developing—scheduled for completion 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.

4. **Ensure data quality consistent with best practices**
   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 fullest extent possible.

5. **Complete documentation of verification and inspection processes**
   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

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

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. 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.

6. **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 (1) require third-party programs to document their verification processes, (2) establish minimum requirements for on-site inspections, (3) fully integrate third-party reporting requirements to be consistent with PSE requirements, and (4) conduct randomly-sampled, internal verification of third-party projects.

7. **Assess and monitor implementation of new evaluation efforts**
   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.

8. **Enhance cost-effectiveness calculations**
   Regarding these, PSE has met the terms of the Settlement Agreement and is using a methodology consistent with Council Guidance. Nonetheless, the review team identified two potential areas of improvement:

   a. Develop a consistent approach for determining incremental measure cost across programs and measures, both for third-party and internal programs.

   b. Consider using weighted average avoided cost based on the mix of end uses within a program.

9. **Provide additional documentation for future avoided cost calculations**
   To provide additional transparency, the review team recommends that the following be included in any new documentation of avoided-costs calculations:

a. Rationale for using either levelized avoided costs or cumulative net present values in their benefit/cost calculations.

b. PSE's 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, as developed in PSE's 2009 IRP.

c. Environmental benefits in addition to carbon prices, such as PSE's application of the 10% Power Act credit as a proxy for additional environmental benefits.

d. Major assumptions about federal legislation. For example, the PSE avoided cost values increase approximately 25% in 2012 and remain higher than the Council's values through 2030. This increase is due to the inclusion of carbon costs in the 2009 IRP's wholesale power price forecast starting in 2012, assuming a U.S. Federal climate change bill being enacted in 2011. In light of the current state of U.S. Federal climate change legislation, inclusion of this assumption should be revisited.

Potential areas of further study

The 2010 portfolio review that the review team performed was designed to be comprehensive, within the schedule and budget constraints of the project. For certain areas we were unable to complete our investigations because of these limitations, and thus we recommend further, more detailed study as part of the overall scope of the review. When this effort 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 be 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 be of limited value. The RCM program, as will be discussed, is the sole remaining program from the initial group for which the review team feels that detailed study is warranted.

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, each the scope of the effort described below. The first two areas focus on specific programs; the second two concern topics that cut across programs.

A. **Resource Conservation Manager Program**. The review team sampled and examined project files for five 2010 RCM projects. We found the documentation of savings to be extensive and thorough. Nonetheless, more detailed review may be justified for several reasons. First, this program accounts for a significant portion (7%) of the electric portfolio claimed savings, with each project accounting for a large amount of savings, on average. Second, 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 would be 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.

Initially, this study will randomly select 20 of the 2010/2011 first half projects (approximately 17% precision at 90% confidence). We will then:

- Review full project files for each sampled project, and assess how savings verification and calculation was performed,
- Categorize completed measures across projects. Select 50%of these projects for detailed interviews with RCMs and program staff to obtain more information.
- Select 25% of interviewed projects for onsite visits to collect additional data and further verify actions taken and savings achieved for key measures.

Results for each sampled site would be reported and aggregated to reach general conclusions about the veracity of 2010-11 savings from the RCM program, as well as recommendations for better verifying and documenting program achievements, if needed.

B. **Single-Family New Construction program**. The review team sampled six projects, accounting for 11 measures, out of those claimed for 2010 for this program (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 obtained for the sampled project in this development was insufficient to determine the veracity the savings, though PSE is willing to make more information available. Because of the complexity and scale of this development, and the fact that it accounts for 15-20% of the 2010 electric savings for this program, the review team recommends that we investigate the projects associated with this development more deeply. This would include meeting with the PSE program manager, and requesting and reviewing additional files for projects associated with large homebuilder.

C. **Measure installation verification, with focus on third-party programs.** 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 recommends a more thorough look at the verification procedures, particularly those concerning third-party and commercial rebate programs. This detailed review would focus 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 would differentiate between practices in place in 2010 and 2011.

E. **Targeted on-site verification[2].** To supplement the file review process, the review team will visit a subset of over 200 projects to verify them through observations and customer interviews. The focus will be on the on 13 of 24 program review domains that were not covered by recent/current evaluations, and where onsite inspections likely will yield meaningful information. Using 2010/2011 first half project samples chosen for the Task 1 file review as a sample frame, the review team will employ an algorithm that accounts for (1) program saving size, (2) third-party administration, (3) measure complexity, and (4) rigor of existing inspections. For each selected project, we will review files and set up on-site verification appointment with customer. The site visit will provide opportunities to confirm as much as possible, through interviews and inspection, that measures associated with project were fully installed and operational. After as many sampled projects as possible are inspected, the review team will aggregate results and develop overall findings. Key research questions for the inspected projects are 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)?

Additional issues or complications may arise during the detailed review. For instance, if significant discrepancies are found in one area, the review team may perform the additional verifications necessary to support a savings adjustment.

[2] Study area "D" is omitted from this list, to keep the letter designations consistent with a master list of potential study topics. The "D" study was eliminated from consideration during discussions between the review team, PSE, WUTC, and CRAG.

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. The Settlement included conditions 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[3]. The Settlement establishes the terms under which PSE has agreed to operate its electric energy efficiency programs. Among the conditions in the Settlement is a requirement to conduct an independent third-party review of the electric energy savings reported by PSE for the 2010-2011 biennium.

This report is the first of several to be developed as part of this third-party review. It documents the objectives of the third-party review, as well as the methodology, findings, and recommendations from each element of the review, specifically relating to the study of PSE's 2010 electric savings claim. This section describes the 2010 PSE electric energy efficiency portfolio, overall review approach, and main data sources. Section 2 presents methodology and findings for the portfolio gross 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. Section 7 is an 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 a target of achieving at least 622,000 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)[4], or from other methods based on impact evaluation data or other relevant data that has verified savings levels.

[3] 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.

[4] 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 latest update of 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 1 provides additional details by program. For 2011, PSE estimates that their portfolio will yield annual electric savings of 340,119 MWh/year, at a cost for the electric portion of $90,795,000.

Table 1: Claimed 2010 Portfolio Electric Savings

Tariff	Program	Sub-program	Expenditures	Savings (MWh/year)
E200	Residential Information Services		$882,368	-
E201	Low Income Weatherization		$2,726,220	2,701
E202	Energy Education		$440,576	-
E214	Single Family existing	Home-print, Water Heat	$1,586,132	1,298
		Residential EE Lighting Rebate	$5,356,178	56,500
		Space Heat	$1,664,576	5,568
		Refrigeration Decommissioning	$891,724	5,724
		Energy Star Clothes Washers	$2,551,998	3,370
		Showerheads	$3,820	587
		Weatherization	$2,519,662	10,117
E215	Single Family New Construction		$1,255,605	2,633
E216	Single Family Fuel Conversion		$793,810	3,163
E217	Multi Family Existing		$4,275,491	11,090
E218	Multi Family New Construction		$1,207,066	2,552
E249	Pilots	Other than Reports	$69,019	188
		Home Energy Reports	$449,911	-
All Residential			**$26,674,156**	**105,491**
E250	Commercial/Industrial Retrofit		$22,366,896	82,618
E251	Commercial/Industrial New Construction		$4,722,188	16,792

Tariff	Program	Sub-program	Expenditures	Savings (MWh/year)
E253	Resource Conservation Manager Services		$921,325	20,169
E255	Small Business Lighting Rebate		$7,248,547	25,178
E257	LED Traffic Signals		$14,101	334
E258	Large Power User - Self Directed		$1,065,122	604
E260	Commercial Energy Efficiency Information		$101,741	-
E262	Commercial Rebate		$2,570,283	18,874
All Business			**$39,010,203**	**164,569**
E254	Northwest Energy Efficiency Alliance (NEEA)		**$4,946,460**	**23,500**
Various	Efficiency support and other related activities		**$4,377,192**	**-**
TOTAL			**$75,008,011**	**293,560**

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 entire 2010-11 electric conservation portfolio were achieved. This report is the first of three interim reports, which assess portfolio accomplishments for all of 2010, the first half of 2011, and all of 2011, respectively. In April 2012, a final report will be issued that integrates and synthesizes these interim reports, and thereby addresses portfolio accomplishments for the entire 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)[5].

Key objectives of the review are enumerated in Table 2 below.

[5] 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.

Table 2: Objectives of Review

Task	Description	Relevant Settlement clause*	Task Objective
1	Portfolio Gross 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.
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 8.1.

The review design encompassed multiple approaches. The review team carefully examined a wide range of selected documents, databases, and calculations underpinning the 2010 PSE 2010-11 portfolio claims. These are enumerated 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 to subject these samples to careful scrutiny and analysis. In conjunction with this, we catalogued issues and problems we identified, and developed a framework for prioritizing particular issues deserving of further detailed review. This overall process is depicted graphically in Figure 2.

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 ensure that PSE continues to comply with the settlement agreement reached with the WUTC.

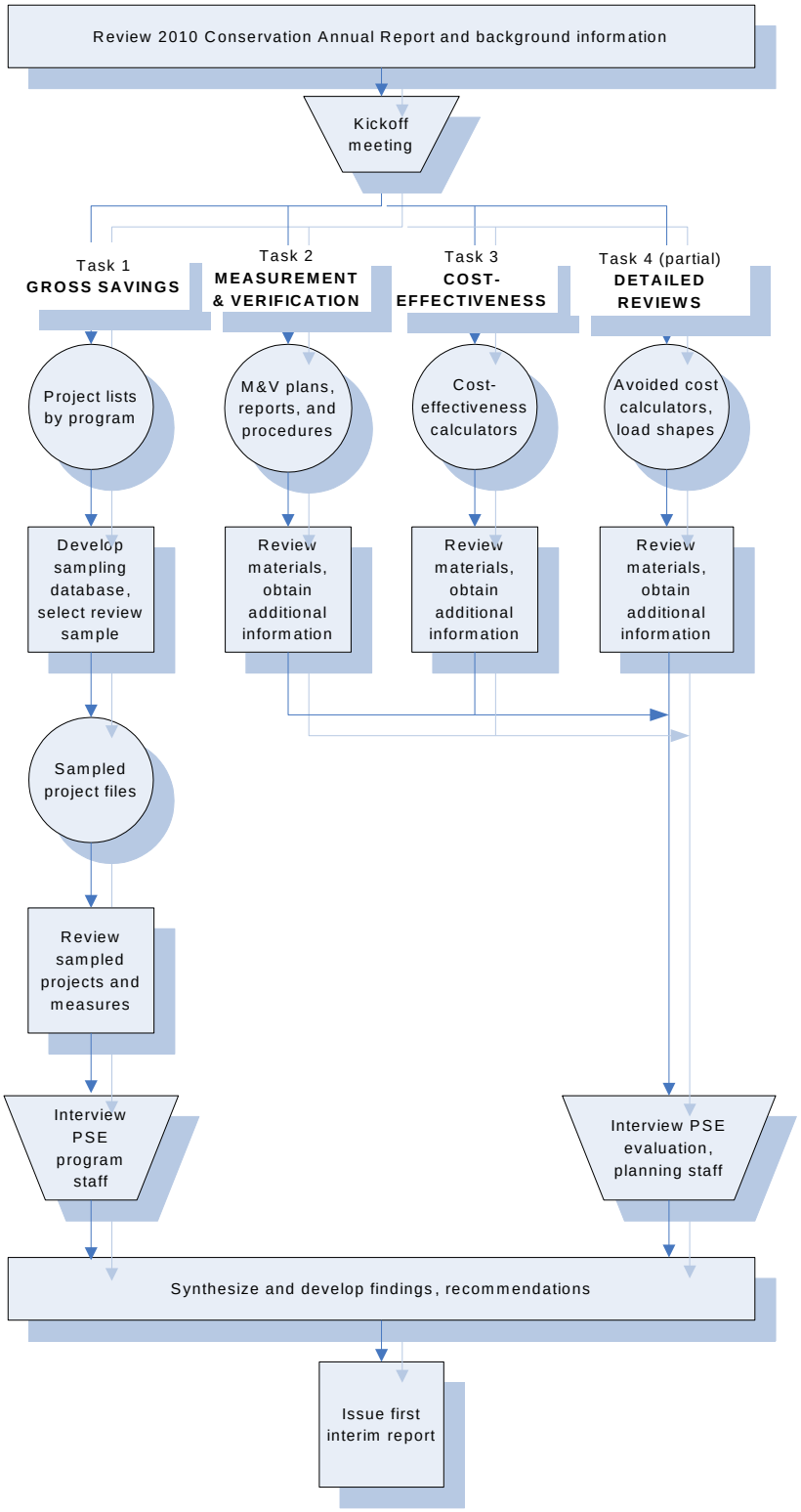


Figure 2: Overview of Third-party Review.

1.3. Data Sources

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

- **2010 Annual Report**: Titled *2010 Annual Report of Energy Conservation Accomplishments*, this PSE report, filed in Docket No. UE-970686 on February 15, 2011, is the primary documentation of the claimed savings from 2010 conservation activities. It presents 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. The report also includes eight 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 underpinned the results shown in the 2010 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 a project review sample frame.
- **Sampled project files**: For the 329 projects (comprising 608 measures) sampled for review, 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.
- **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 a current version of this database 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 present. Also supplied were plans for ongoing evaluations, as well as planning documents that describe current evaluation policies, guidelines, and approaches.
- **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. The latter included a draft version of PSE's 2011 integrated resource plan.

An itemized listing of all formal data sources can be found in the appendix (Section 8.2).

1.4. Acknowledgements

The authors wish to acknowledge and express our gratitude to the many individuals who provided contributions of time and information to this review. Without their support and assistance, this effort would not have been possible. These include the following Individuals at Puget Sound Energy: Dan Anderson, Eric Brateng, Syd France, Andy Hemstreet, Bill Hopkins, Steve Johns, David Landers, Bob Stolarski, Jeff Tripp, Bobbi Wilhelm, and many of their associates. Additionally, Dave Nightingale at the Washington Utilities and Trade Commission provided valuable guidance.

2. PORTFOLIO GROSS SAVINGS REVIEW

The objective of this review was to determine the veracity of total portfolio gross 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.

2.1. Methodology

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. 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.

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 Annual Report and Supporting Data

The 2010 annual report consisted of two discrete documents in PDF format[6]. The team reviewed these documents and excerpted the claimed savings for each program and activity. We also obtained the master spreadsheets containing the numbers shown in the report tables[7]. These were followed later with several replacement tables that corrected a minor error in one of the programs[8].

Before selecting the sample, 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 the 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

[6] # 1, 2 in the list of data sources in Section 7.2.

[7] #24, 25 ibid.

[8] #-54-57 ibid.

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 evaluation sample was drawn.

Table 3 and Table 4 below provide a detailed breakdown of the residential and business energy management programs, respectively. The tables include brief descriptions of program services, as well as the total expenditures and electric savings in 2010, as documented in the PSE 2010 Annual Report. Overall, the portfolio claims annual savings of 293,560 MWh/year, obtained with expenditures of about $75 million. There are 16 tariffs for which PSE has claimed savings, ranging from very small programs, such as the Pilot programs (E249) with claimed savings of 188 MWh/year, to the Commercial/Industrial Retrofit program, with claimed savings of 82,618 MWh/year.

Table 3: 2010 Residential Energy Management Programs

Tariff	Program	Sub-program	Description of program services	Expenditures	Savings (MWh/year)	% of total portfolio savings
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.	$882,368	-	-
E201	Low Income Weatherization		Weatherization and energy-related repairs for low-income, single- and multi-family residences, including mobile homes.	$2,726,220	2,701	1%
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.	$440,576	-	-
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.	$1,586,132	1,298	0.4%
		Residential EE Lighting Rebate	Compact fluorescent (CFL) lamps and fixtures	$5,356,178	56,500	19%
		Space Heat	Air-source, geothermal, and ductless heat pumps.	$1,664,576	5,568	2%
		Refrigeration Decommissioning	Disposal of surplus, high-energy-usage refrigerators and freezers.	$891,724	5,724	2%
		Energy Star Clothes Washers	Efficient washers.	$2,551,998	3,370	1%
		Showerheads	Low-flow showerheads.	$3,820	587	0.2%
		Weatherization	Home insulation and HVAC duct sealing.	$2,519,662	10,117	3%
E215	Single Family New Construction		Rebates and incentives for efficient lighting, appliances, HVAC, water heating in new single-family residences, including manufactured homes.	$1,255,605	2,633	1%

Tariff	Program	Sub-program	Description of program services	Expenditures	Savings (MWh/year)	% of total portfolio savings
E216	Single Family Fuel Conversion		Incentives to replace electric space or water heating equipment with high-efficiency gas counterparts.	$793,810	3,163	1%
E217	Multi Family Existing		Rebates and incentives for efficient lighting, appliances, HVAC, water heating, and improved building envelope components.	$4,275,491	11,090	4%
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.	$1,207,066	2,552	1%
E249	Pilots	Other than Reports	Heat pump air handler/furnace fan motor upgrade; heat pump sizing and lockout controls; natural gas fireplaces.	$69,019	188	0.1%
		Home Energy Reports	Customized reports to help residential customers understand their energy usage and find ways to save.	$449,911	-	
All Residential				**$26,674,156**	**105,491**	**36%**

Table 4: 2010 Business Energy Management Programs

Tariff	Program	Sub-program	Description of program services	Expenditures	Savings (MWh/year)	% of total portfolio savings
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.	$22,366,896	82,618	28%
E251	Commercial/ Industrial New Construction		Incentives for efficiency upgrades that exceed codes/standard practice for new facilities or major remodels of all sizes.	$4,722,188	16,792	6%
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.	$921,325	20,169	7%

Tariff	Program	Sub-program	Description of program services	Expenditures	Savings (MWh/year)	% of total portfolio savings
E255	Small Business Lighting Rebate		Rebates for a wide range of lighting conversions in small businesses. Also provides a contractor and vendor network.	$7,248,547	25,178	9%
E257	LED Traffic Signals		Information and rebates for public sector customers w/traffic control authority.	$14,101	334	0.1%
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.	$1,065,122	604	0.2%
E260	Commercial Energy Efficiency Information		[see Residential Tariff E200]	$101,741	-	-
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.	$2,570,283	18,874	6%
All Business				$39,010,203	164,569	56%
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.	$4,946,460	23,500	8%
Various	Efficiency support and other related activities		Numerous support activities, such as program evaluation, market research, supply curves, and pilot programs.	$4,377,192	-	-
TOTAL				**$75,008,011**	**293,560**	**100%**

Develop 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

We then assembled the various project lists and databases into a comprehensive sample frame, and developed a preliminary 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 it, the review team submitted the plan to PSE, WUTC, and the CRAG to confirm it was acceptable. Once the 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 5 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. 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.

Table 5: 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	
		Savings	kWh savings	
			Hours of operation	
		Costs	Measure cost	
			Incentive payment amount	
			Incentive payment date	
Measure Metrics data			Measure type	
			Unit savings	
			Measure cost	

Data class	Category	Subcategory	Parameter	Third-party review questions
			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?
				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?

2.2. Findings

2.2.1. High-level portfolio review

Our comparison of reported savings to program tracking database savings is provided in Table 6 below. 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 Table 6. PSE's revised submittal from April 2011 reflects this latter value.

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 6: Comparison of PSE Report and Database Savings

Code	Program Name	Program Element	2010 Report Savings	Database Savings
E200	Residential Information Services		0	0
E201	Low Income Weatherization		2,701	2,701
E202	Energy Education	Energy Education	0	0
E214	Single Family existing	Energy Star Clothes Washers	3,370	3,370
		Home-print/Water Heat	1,298	1,298
		Refrigeration Decommissioning	5,724	5,724
		Residential EE Lighting Rebate*	**56,500**	**56,690**
		Showerheads	587	587
		Space Heat	5,568	5,568

Code	Program Name	Program Element	2010 Report Savings	Database Savings
		Weatherization	10,117	10,117
E215	Single Family New Construction		2,633	2,633
E216	Single Family Fuel Conversion		3,162	3,162
E217	Multi Family Existing		11,090	11,090
E218	Multi Family New Construction		2,552	2,552
E249	Pilots	Home Energy Reports	0	0
		non-Home Energy Reports	188	188
E250	C/I Retrofit		82,618	82,618
E251	C/I New Construction		16,792	16,792
E253	Resource Conservation Manager - RCM		20,169	20,169
E255	Small Business Lighting Rebate		25,178	25,178
E257	LED Traffic Signals		334	334
E258	Large Power User - Self Directed		604	604
E262	Commercial Rebate		18,874	18,874

* Difference reflects correction made in report revision to account for double-counted rebate coupons.

2.2.2. Project-level review

Table 7 shows the total number of projects the review team established for each PSE program. The 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 2.1 to develop a review sample of 185 residential and 112 business sector projects, for a total of 297 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 review team did not sample the Home Energy Report component of the E249 Pilot Programs, since there were no claimed savings associated with this pilot and there were no individual project files to review. In a similar vein, 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.

Table 8 provides a qualitative summarization for each program of the reported savings, cost, and incentive values that the team encountered while reviewing the sampled projects. The table also provides a simple pass-fail designation by program to indicate if information obtained about the sampled projects was adequate to confirm the veracity of the savings and costs. Applying this system all the programs passed, though for two of the programs, namely—Single Family New Construction (E215) and RCM (Resource Conservation Manager) (E253)—the review team recommends more detailed study as part of the next steps in the portfolio review. The rationale for these recommendations is as follows:

- **Single-Family New Construction program**. The review team sampled six projects, accounting for 11 measures, out of those claimed for 2010 for this program (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 obtained for the sampled project in this development was insufficient to determine the veracity the savings, though PSE is willing to make more information available. Because of the complexity and scale of this development, and the fact that it accounts for 15-20% of the 2010 electric savings for this program, the review team recommends that we investigate the projects associated with this development more deeply.
- **Resource Conservation Manager Program**. The review team sampled and examined project files for five 2010 RCM projects. We found the documentation of savings to be extensive and thorough. Nonetheless, more detailed review may be justified for several reasons. First, this program accounts for a significant portion (7%) of the electric portfolio claimed savings, with each project accounting for a large amount of savings, on average. Second, 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 would be 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.

Ultimately, though, the review team was generally satisfied with the documentation and explanations they were given regarding the claimed savings for the sampled projects. Overall, it appears that PSE has done a credible job of tracking and reporting program accomplishments for the 2010 electric efficiency portfolio. 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 the next section (refer to Section 3.1 Tracking and reporting processes).

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, which is discussed in more detail later in this report (refer to Section 3.1). 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 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 7: Project Review Sample

Program Number	Sampling Domain	Subprogram	Total Project Count	Reviewed Project Count	Reviewed Measure Count
E201	Low Income Weatherization	n/a	650	6	15
E214	Single Family Existing Exclude Weatherization	Energy Star Clothes Washers	21,866	25	25
		Homeprint/Water Heat	1,742	7	9
		Refrigeration Decommissioning	6,061	44	44
		Residential EE Lighting Rebate	59	12	21
		Showerheads	4,291	4	4
		Space Heat	3,091	22	22
	Single Family Existing Weatherization	Weatherization	4,919	20	41
E215	Single Family New Construction	n/a	4,695	8	11
E216	Single Family Fuel Conversion	n/a	500	7	7
E217	Multi Family Existing	n/a	221	23	44
E218	Multi Family New Construction	n/a	15	5	21
E249	Pilots	non-Home Energy Reports	184	2	2
Residential Energy Management (REM) Total			48,294	**185**	**266**
E250	Commercial/industrial (C/I) Energy Smart Grocer	n/a	368	6	24
	C/I Lighting	n/a	534	9	10
	C/I Retrofit HVAC/Other	n/a	144	5	5
	C/I Retrofit Industrial/Process	n/a	46	2	2

Program Number	Sampling Domain	Subprogram	Total Project Count	Reviewed Project Count	Reviewed Measure Count
E251	C/I New Construction	n/a	41	6	14
E253	Resource Conservation Manager	n/a	72	5	5
E255	C/I Lighting	n/a	1,585	61	211
E257	LED Traffic Signals	n/a	3	2	6
E258	High Voltage	n/a	5	2	2
E262	C/I Lighting	n/a	149	4	6
	Commercial Rebate, excluding Lighting	n/a	652	10	10
Business Energy Management (BEM) Total			**3,599**	**112**	**295**
PORTFOLIO TOTAL			**51,893**	**297**	**561**

Table 8: Project Review Summary

			General Assessment of Sampled Projects		
Pro-gram #	Sampling domain	Sub-program	Savings Values	Cost & Incentive Values	Overall
E201	Low Income Weatherization	n/a	The majority of the measures use deemed savings values, while two measures use a program calculator to determine savings.	The majority of the measures use deemed incentives, while two measures use program-calculator-defined incentives. Measure cost invoices are not provided for the majority of the records, but they can be requested from the third-party program implementer.	Pass
E214	Single Family Existing Exclude Weatherization	Energy Star Clothes Washers	All reviewed measures use Measure Metrics deemed savings based on equipment model number.	All reviewed measures use deemed Measure Metrics incentive and measure cost based on equipment model number.	Pass
		Homeprint/ Water Heat	The majority of the reviewed measures use Measure Metrics deemed savings based on equipment model number, while two are gas DHW measures with no kWh savings claimed.	The majority of the reviewed measures use Measure Metrics deemed incentives based on equipment model number, while two are gas DHW measures with no incentive, and the claimed measure cost is zero for all records.	Pass
		Refrigeration Decommis-sioning	All reviewed measures use the same Measure Metrics deemed savings, which is an RTF savings value.	All reviewed measures use same Measure Metrics deemed incentive and zero measure cost.	Pass
		Residential EE Lighting Rebate	All reviewed measures use Measure Metrics deemed savings for either CFL or fixture.	All reviewed measures are retailer markdown and billed to PSE so zero incentive and zero measure cost.	Pass
		Shower-heads	All reviewed measures use the same Measure Metrics deemed savings, which is a modified RTF savings value.	All reviewed measures are mailed to customer, so zero incentive and zero measure cost.	Pass
		Space Heat	All reviewed measures use Measure Metrics deemed savings, with the majority based on HSPF factor from	All reviewed measures use Measure Metrics deemed incentive, with the majority based on HSPF factor from	Pass

Pro-gram #	Sampling domain	Sub-program	General Assessment of Sampled Projects Savings Values	Cost & Incentive Values	Overall
			certificate of product rating and several based on general measure type.	certificate of product rating, and several based on general measure type, and the claimed measure cost is zero for all records.	
	Single Family Existing Weatherization	Weatheriza-tion	Projects reviewed both used Measure Metrics for savings.	Projects reviewed both used Measure Metrics for incentive.	Pass
E215	Single Family New Construction	n/a	All reviewed measures used Measure Metrics deemed savings values.	All reviewed measures used Measure Metrics deemed incentive. The claimed measure cost is zero for all records.	**Pass, but detailed review recom-mended**
E216	Single Family Fuel Conversion	n/a	All but one reviewed measures used Measure Metrics deemed savings values. The exception was a program adjustment line.	All but one reviewed measures used Measure Metrics deemed incentives. The exception was a program adjustment line.	Pass
E217	Multi Family Existing	n/a	The majority of the records used Measure Metrics or other deemed savings, a few records used a program calculator, and a couple records had custom calculated savings.	The majority of the records used Measure Metrics or other deemed incentive, a few records used a program calculator, and a couple records have custom calculated incentive. The claimed measure cost is zero for a majority of records and the non-zero claimed measure costs are based on invoices.	Pass
E218	Multi Family New Construction	n/a	The majority of reviewed measures used Measure Metrics deemed savings based on general measure type, a couple measures had custom calculated savings, several measures used program calculator savings, and	The majority of reviewed measures used Measure Metrics deemed incentive based on general measure type, a couple measures had a custom incentive, several measures use program calculator incentive. The incentive is	Pass

Program #	Sampling domain	Sub-program	General Assessment of Sampled Projects Savings Values	Cost & Incentive Values	Overall
			one measure was an adjustment record.	zero for measure adjustment record, and the claimed measure costs are zero for all records.	
E249	Pilots	non-Home Energy Reports	Both reviewed measures used a Measure Metrics deemed savings value.	Both reviewed measures used a Measure Metrics deemed incentive and measure costs based on invoices.	Pass
E250	Commercial/industrial (C/I) Lighting		Program calculator was used for all measure savings values.	Program calculator was used for all measure incentive values.	Pass
	C/I Energy Smart Grocer		Savings for all projects based on PECI calculations.	Costs for all projects based on invoices, while incentives were deemed.	Pass
	C/I Retrofit HVAC/Other		All reviewed measures had custom calculated savings.	All reviewed measures had custom incentive, and measure costs based on invoices	Pass
	C/I Retrofit Industrial/Process		Both reviewed records had custom calculated savings, but one record is the negative kWh savings from a gas saving measure.	One record has custom incentive and measure cost based on invoices, and the gas saving measure has no claimed incentive or cost as they are listed with the gas measure	Pass
E251	C/I New Construction		The majority of reviewed measure had custom calculated savings, a couple records used Measure Metrics deemed savings based on measure type, and one record used program calculator savings.	The majority of reviewed measure had custom calculated incentives, a couple records used Measure Metrics deemed incentives based on measure type, and one record used program calculator incentives. All records had measure cost based on invoices.	Pass
E253	Resource Conservation Manager		Savings based on calculations submitted by resource conservation managers, adjusted by PSE for weather, square footage changes, etc.	Costs based on RCM report, incentive based on savings.	**Pass, but detailed review recom-mended**

			General Assessment of Sampled Projects		
Pro-gram #	Sampling domain	Sub-program	Savings Values	Cost & Incentive Values	Overall
E255	C/I Lighting		Program calculator used for all measure savings values.	Program calculator used for all measure incentive values.	Pass
E257	LED Traffic Signals		All reviewed measures used Measure Metrics deemed saving based on lamp type.	All reviewed measures used Measure Metrics deemed incentive based on lamp type and have a claimed measure cost of zero.	Pass
E258	High Voltage		Both reviewed measures used a program calculator for savings.	Both reviewed measures used a program calculator for incentive and measure cost based on invoices.	Pass
E262	C/I Lighting		Program calculator was used for all measure savings values.	Program calculator was used for all measure incentive values.	Pass
	Commercial Rebate, excluding Lighting		The majority of the measures used deemed savings values, while a couple of measures used a program calculator to determine savings.	The majority of the measures used deemed incentives, while a couple of measures used the program calculator defined incentive.	Pass

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 gross savings review (Task 1), 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).

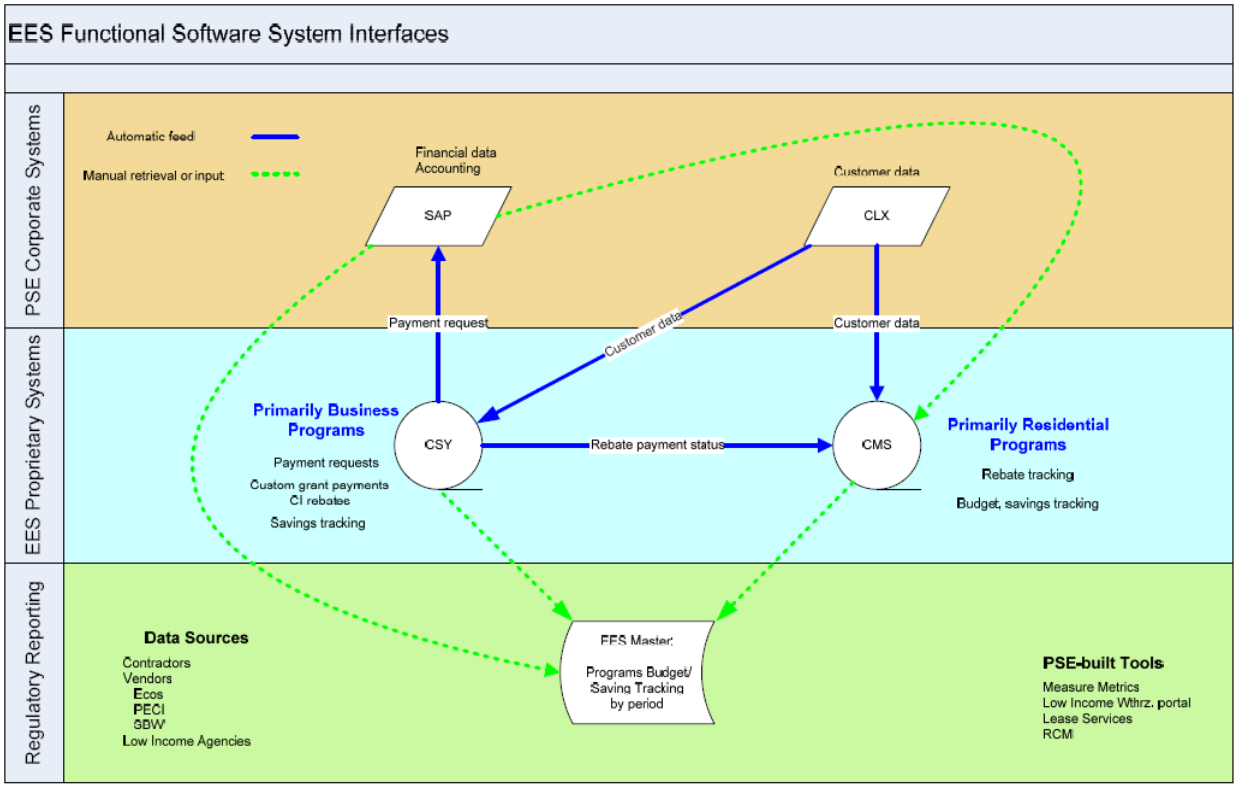
To their credit, PSE has already identified numerous areas for potential improvement. In this section, we summarize those areas and amplify some of their conclusions based on our own experiences with PSE

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 3 provides a graphical summary of PSE's tracking systems, as presented in their 2010 annual report. It is provided to supplement the discussion.



(Reproduced from Figure 2c in the PSE 2010 Annual Report of Energy Conservation Accomplishments.)

Figure 3: Energy Management Tracking and Reporting Interface.

The five main systems shown in Figure 3 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 however, 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.

- **EES 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[9] that reviewed "best practice" programs nationwide, it is vital to have the following elements in a tracking and reporting system independent of program type:

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.

[9] 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).

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[10].

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.

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.

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

3.2. Measure installation verification

3.2.1. 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 gross 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

Key files reviewed include the following[11]:

- 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.

[11] Refer to # 66, 158, 159, 163, and 164 in the list of data sources in Section 7.2.

- 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.

3.2.2. Findings

Best Practices

Relevant best practices for quality control and verification, as drawn from the National Energy Efficiency Best Practices study[12], 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.

[12] Refer to Footnote 9.

i. For residential new construction, require the builder or builder's representative to be on-site during inspection.

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.

3.3. 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 9 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 Table 23 in the Appendix (the letter designations in Table 9 are cross-referenced to this table). The details in Table 23 include 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[13] 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.

[13] 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 9: Overview of Recent EM&V Studies

Note: Capital letters in matrix refer to specific M&V studies, as listed in the appendix (Section 7.4).

	Schedule	Program/Sub-program	Program year studied (# = pending). Triangle (△)indicates year report issued.															Claimed savings		Recently evaluated	
			2005 or prior			2006			2007			2008			2009			2010			2011			In 2010	% of claim		
			Impact	Process	Market	Impact	Process	Market	Impact	Process	Market	Impact	Process	Market	Impact	Process	Market	Impact	Process	Market	Impact	Process	Market			Impact	Process
Residential	E150	Net Metering																									
	E200	Residential Information Services																									
	E201	Low Income Weatherization																			#	#	#	2,701	1%	1	1
	E202	Energy Education																									
	E214	Single Family existing																			#	#	#	83,164	28%		
		Showerheads							A			△												*587*	*0.2%*	1	
	E215	Single Family New Construction																						2,633	1%		
	E216	Single Family Fuel Conversion																						3,163	1%		
	E217	Multi Family Existing							B			B			B						△			11,090	4%		
	E218	Multi Family New Construction																						2,552	1%	1	
	E241	Community Efficiency Manager																									
	E248	Small Scale Renewables																									
	E249	Pilots: Home Energy Reports										C			C			C△						-	0%	1	
		Pilots, excluding Home Energy Reports																						188	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				82,618	28%	1	1
	E251	C/I New Construction	H (lighting)						△															16,792	6%	1	
	E253	Resource Conservation Manager - RCM	I	J		I	J		I	J△		I△												20,169	7%	1	
	E254	NW Energy Efficiency Alliance																						23,500	8%		
	E255	Small Business Lighting Rebate	H (lighting)						△															25,178	9%	1	
	E257	LED Traffic Signals													E	F	G	E	F	G				334	0.1%	1	1
	E258	Large Power User - Self Directed													E	F	G	E	F	G				604	0.2%	1	1
	E260	Commercial Energy Efficiency Information																									
	E261	Energy Efficient Technology Evaluation																									
	E262	Commercial Rebates																						18,874	6%		
		[Premium Service HVAC]										K	L		K△	L△								*4,403*	*1.5%*	1	1
		[PC Power Management]													M			M			△			*2,546*	*0.9%*	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 9 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 programs--included only four impact and two process evaluations of the measure groups and programs, as listed in Table 10. 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 10: EM&V Studies Relevant to 2010 Programs

Third-party review ID (from Table 9)	Program	% of portfolio savings
A (impact)	Showerheads (a part of program E214)	0.2%
H (impact)	Commercial Lighting (parts of programs E250, 251, and 254)	24.0%
I (impact), J (process)	Resource Conservation Manager (E253)	6.9%
K (impact), L (process)	Commercial Rebates – Premium HVAC Service (part of E262)	1.5%
O (impact), P (market)	Various residential and business programs with CFL measures	--

Collectively, these evaluated areas accounted for 34% of the claimed 2010 portfolio savings, with the bulk of that percentage consisting of commercial lighting. Another way of stating this is say that nearly two-thirds 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.

The current evaluation plan calls for $1,468,000 in electric program evaluation over the 2010-11 biennium. Built into the planning are budget contingencies, to allow for immediate action to address special needs. An example of this would be changes that arose from the recommendations of the recently-completed impact evaluation of the Multi-family Existing Program (E217). This contingency will fund follow-up evaluation work to determine how effective the changes are.

This increase in PSE's evaluation planning rigor corresponds with increased budgetary resources. Table 11 shows actual annual expenditures for both program evaluation and research and market research activities over the past five years. What is clear is that 2010 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, compared to its historical level of about $500,000. Formal M&V activities last year accounted for 1.4% of total electric portfolio costs, compared to 1.0% historically.

Table 11: 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%
2007-09 avg.	**$518,146**	**$574,694**	**$1,092,840**	**$53,057,882**	**1.0%**	**2.1%**
2010	**$1,026,341**	**$580,052**	**$1,606,393**	**$75,008,018**	**1.4%**	**2.1%**

PSE has also been establishing a quality assurance (QA) group that will operate independently of the program groups. The QA group would perform verification activities currently done by program staff. This QA work would occur 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 12 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. As of this writing, PSE has begun 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 expects to have a new evaluation framework approved for adoption by September 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 12: 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 13 were considered part of the current evaluation plan and were reviewed in more detail against best practices:

Table 13: Current Evaluations

Third-party review ID (from Table 9)	Program
B (impact)	Multi-Family Existing (E217)
C (impact)	Pilots/Home Energy Reports (part of program E249)

Third-party review ID (from Table 9)	Program
D (impact)	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)
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. The absence of 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 14, the activities described in the work plan for this evaluation were reviewed and found to cover many elements of process evaluations, as outlined by the National Action Plan for Energy Efficiency.

Table 14: Review of Process Evaluation Elements

Elements of Process Evaluation	Report "F" Third-party review ID (from Table 13)
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
3. Program Implementation	
3.1 Quality control	Planned
3.2 Operation practice -- how program is implemented	Planned
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

Elements of Process Evaluation	Report "F" Third-party review ID (from Table 13)
5. Overall Assessment	
5.1 External or internal evaluators	External
5.2 Number of data collection methods	7

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 15. 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 15: Review of Impact Evaluation Components

Component		Third-party review ID (from Table 13)					
		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	P
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	2 in Prop
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	NA

Component		Third-party review ID (from Table 13)					
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	3
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	NA
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 in Prop
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	2
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	EM in Prop
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.

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)). [14]

In addition, PSE analysis must include quantifiable non-energy benefits, the 10 percent conservation benefit, and a risk adder consistent with the Council approach.[15] 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 annual conservation report. The team documented the following elements to confirm if PSE is in compliance with the prior (above) settlement agreement.

[14] 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.

[15] 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[16]
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[17] 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 Task 4. Here, the team discusses our observations in light of WSCWG's results.

[16] 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.

[17] 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.

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[18]), 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 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

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

PSE levelizes 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.[19] 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 = 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.

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)[20]. 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 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 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.[21] The

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

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

[21] 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.

PSE cost-effectiveness standard value per kWh is taken from the sheet "ElecCEStd2010-2011 w ConsCred", 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

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 1. Details of the calculation inputs, per the third party review are provided in this section.

The following table summarizes WSCWG's observations on PSE 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,

Table 16: 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.

	Council	PSE	Consistency with Council Method
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			
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.[22]	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.

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

	Council	PSE	Consistency with Council Method
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.
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 task 4 review of avoided energy costs 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[23] 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[24]). PSE is using load shapes developed by the Cadmus Group for PSE's 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 17: 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

[23] 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).

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

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.

ProCost assumes that administrative costs are 20% of the initial cost of capital (measure costs). However, the team varied this value for each program analyzed using ProCost. The actual percent administration cost allocations by program are summarized in the following table.

Table 18: Actual Programs Costs as a Percentage of Measure Costs

Program Name	Admin Cost as % of Measure Costs
Low Income	11%
Single-Family Existing	24%
Single-Family New Construction	54%
Single-Family Fuel Conversion	5%
Multi-Family Existing	18%
Multi-Family New Construction	12%
Total Residential Efficiency Programs	22%
C/I Retrofit	8%
C/I New Construction	4%
Resource Conservation Manager - RCM	46%
Small Business Lighting Rebate	7%
LED Traffic Signals	1%
Large Power User - Self Directed	5%

Program Name	Admin Cost as % of Measure Costs
Commercial Rebates	9%
Total Business Efficiency Programs	9%
Total Portfolio	14%

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[25]. 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 and in task 1.

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[26].

[25] 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).

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

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.

Methodology Comparison

Since the ProCost calculations are done in Macros and there is no documentation, the 3PR 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.

- 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.

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 19: ProCost Inputs

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

Table 21: 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
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 22: 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 Bobbi Wilhelm for the EES group. The recommendations are discussed in task 2 under tracking system review.

Avoided Costs

The team reviewed the derivation of average annual avoided costs used in the Appendix D workbook. These avoided costs values are used to calculate the benefits related to the energy savings. The table below shows the levelized avoided costs in $/kWh, which include both avoided energy and capacity costs. This table does not include the conservation credit of 10%;27 however, a simple multiplication of these values times 110% yield the avoided costs with conservation credit (used with the TRC calculation).

[27] 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 23: 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

To calculate these values, multiple steps were taken and are documented within the "CE Std 10-11_Electric_wo 10% cons credit.xls" workbook.[28] 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 prior levelized cost values.

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[29].

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 $/MWh. For some load shapes, some assumptions were used. For example, commercial lighting average is based on office building even though analysis is available for warehouse, university, school, restaurant, hotel, hospital, grocery, and dry goods. This was done to simplify the cost-effectiveness analysis when end use load shapes were similar to each other and did not affect the overall weighted average.
4. These annual weighted averages of hourly price per year ($/MWh) per end use was then transferred to the "CE Std 10-11_Electric_wo 10% cons credit.xls" 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.

[28] 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".

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

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

Commercial T&D Losses[30]:	6.40%
Residential T&D Losses:	7.90%
Nominal Discount Rate[31]:	8.25%
GDP Inflation[32]:	2.5%
Planning Adjustment[33]:	23%
Conservation Credit[34]:	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 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).

- 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])

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

[31] Nominal discount rate is equal to PSE weighted average long run cost of capital.

[32] From the 2009 IRP process.

[33] 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%.

[34] 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.

- 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]).

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

Deferred T&D Cost Credit ($/kw-yr)[35]:	$45.56
NW Power Act Regional Credit[36]:	10.0%
Nominal Discount Rate[37]:	8.25%
GDP Inflation[38]:	2.5%
Reserve Margin Credit[39]:	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]

The total annual capital and fixed costs of capacity are transferred from the PSE integrated resource plan. These values are then calculated into the levelized cost effectiveness standard-capacity 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%.

[35] 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.

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

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

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

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

- 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.

5. The final step required calculating the sum of avoided costs for energy and capacity, which are presented as the levelized avoided-cost values for the cost-effectiveness calculations in Appendix D. 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. Typically, 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[40]. Further analysis must be completed to assess this assumption.

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 task 3, the team verified the values entered into the program level 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 part of task 1. The team reviewed if the proper measure life was used for the overall program to calculate cost-effectiveness for task 3. 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.

[40] 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.

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

The load shape defined at the program level dictates 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 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 24: 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.

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.

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. 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. Residential

   - 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.

2. Commercial and Industrial

   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; however, this is not always the case. For HVAC measures, the team used the deemed IMC value. However, the full cost from the invoice may be used for commercial kitchen equipment. 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.

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.[41]

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. Administrator costs are on average 14% of the total measure costs and 16% of the total program costs. Therefore, these represent a significant variable of total program cost-effectiveness.

Incentives and Energy Savings

The incentive value is considered only in the UC test. No review of the incentive and savings values was included in this task. Savings were reviewed under task 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 Low Income, which is hard coded. Additionally, E214, single-family rebates were not detailed in the Appendix D calculations. However, the savings and incentives were verified via database extracts gathered for task 1.

4.3. 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.
   - PSE is consistent with the Council's methodology. Differences include:
     - Average annual avoided costs versus four segments monthly
     - Non-energy benefits are not included

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

- Program level calculations, not measure level
- 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.

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®[42] 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).

[42] 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 20 lists the sources used and the inputs they are used for.

Table 25: Resource Plan Input Data Sources

Inputs	PSE	NPCC
National economic growth	Moody's	HIS Global Insights[43]
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 21. 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.

[43] 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 26: Input Assumptions

Assumption	PSE	Council
Electric energy growth (demand)	2.1% per year[44]	1.2% per year[45]
Electric peak load growth	1.7% per year[46]	1.1% per year[47]
Electricity price increase	3.7-6.2% through 2014 2.1-2.6% after[48]	1% per year[49]
Transmission position	Constrained	Constrained
Electric transmission line losses	6.8%[50]	1.9-7.0% depending on resource type[51]
Carbon prices	$18/ton in 2013 $69/ton in 2031[52]	$20/ton in 2013 $47/ton in 2030[53]
Discount rate	Calculated at 8.1% nominal* pre-tax using PSE internal weighted average cost of capital[54] Real = 5.6% (8.1-2.5)	Calculated at 5.0% real* pre-tax using market rate estimate for various entity types[55]
Inflation rate	2.5%[56]	2.5%[57]
Investment tax credits	30% through 2012[58] Resource type not specified	30% solar through 2016 0% wind[59]
Production tax credits	Wind $21/MWh end in 2012[60]	Wind $21/MWh end in 2012[61]

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

[44] PSE IRP 2011 DRAFT, figure H-5, page H-12

[45] Council Sixth plan, 2010, table 3-3, page 3-5

[46] PSE IRP 2011 DRAFT, figure H-8, page H-12

[47] Council Sixth plan. 2010, page 3-7

[48] PSE IRP 2011 DRAFT, page H-5

[49] Council Sixth plan, 2010, page 2-17

[50] PSE IRP 2011 DRAFT, page H-6

[51] NPCC Sixth plan, 2010, page 6-45

[52] PSE IRP 2011 DRAFT, page 4-7

[53] Council Sixth plan, page 2-9

[54] PSE IRP 2011 DRAFT, page I-27

[55] Council Sixth Plan, page N-8 (commercial, residential, industrial)

[56] PSE IRP 2011 DRAFT, 4-11

[57] Council Sixth Plan, page B-36

[58] PSE IRP 2011 DRAFT, 4-12

[59] Council Sixth Plan, page B-36

[60] PSE IRP 2011 DRAFT, I-8

[61] Council Sixth Plan, page 6-20, 9-19

Additional Comments and Recommendations

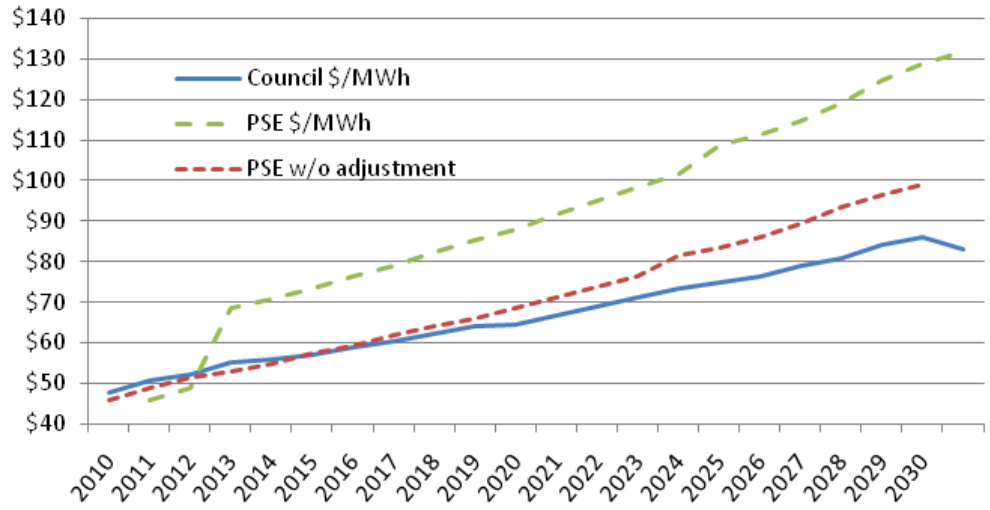
To provide additional transparency, we recommend that the following be included in any new documentation of avoided-costs calculations:

- 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.[62] 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.[63] 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 Table 22 along with current avoided cost values.

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

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

Table 27: 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

Overall, the review team has confirmed the veracity of PSE's 2010 portfolio savings claim. While there are particular areas where we would like to investigate further, we did not find any major problems with the numbers and the underlying documentation of the sampled projects that we reviewed. The team also 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, and developed recommendations for addressing these areas. While many of these recommendations have been apparent to PSE for some time, they are listed 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.

General recommendations

1. **Develop consistent and complete program tracking databases**

   PSE database activity occurs over a patchwork of systems. Some of these databases are partially documented. As the program activity and evaluation efforts increases, 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 increment/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 varied across programs. 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—the comprehensive database for tracking savings histories for all deemed measures—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[64].

2. **Carefully document how to use 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 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 developing—scheduled for completion 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.

4. **Ensure data quality consistent with best practices**
   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.

5. **Complete documentation of verification and inspection processes**
   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. The RCM program would benefit from clear guidelines on project file documentation to ensure that appropriate savings and incentive calculations are done on all

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

projects. The Small Business Lighting program might consider documenting equipment qualification, as well as clarifying the use of collected operating hours in savings calculations.

6. **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 (1) require third-party programs to document their verification processes, (2) establish minimum requirements for on-site inspections, (3) fully integrate third-party reporting requirements to be consistent with PSE requirements, and (4) conduct randomly-sampled, internal verification of third-party projects.

7. **Assess and monitor implementation of new evaluation efforts**
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.

8. **Enhance cost-effectiveness calculations**
Regarding these, PSE has met the terms of the Settlement Agreement and is using a methodology consistent with Council Guidance. Nonetheless, the review team identified two potential areas of improvement:

    a. Develop a consistent approach for determining incremental measure cost across programs and measures, both for third-party and internal programs.

    b. Consider using weighted average avoided cost based on the mix of end uses within a program.

9. **Provide additional documentation for future avoided cost calculations**
To provide additional transparency, the review team recommends that the following be included in any new documentation of avoided-costs calculations:

    a. Rationale for using either levelized avoided costs or cumulative net present values in their benefit/cost calculations.

    b. PSE's 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, as developed in PSE's 2009 IRP.

    c. Environmental benefits in addition to carbon prices, such as PSE's application of the 10% Power Act credit as a proxy for additional environmental benefits.

    d. Major assumptions about federal legislation. For example, the PSE avoided cost values increase approximately 25% in 2012 and remain higher than the Council's values through

2030. This increase is due to the inclusion of carbon costs in the 2009 IRP's wholesale power price forecast starting in 2012, assuming a US Federal climate change bill being enacted in 2011. In light of the current state of U.S. federal climate change legislation, inclusion of this assumption should be revisited.

Potential areas of further study

The 2010 portfolio review that the review team performed was designed to be comprehensive, within the schedule and budget constraints of the project. For certain areas we were unable to complete our investigations because of these limitations, and thus we recommend further, more detailed study as part of the overall scope of the review. When this effort 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 be 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 be of limited value. The RCM program, as will be discussed, is the sole remaining program from the initial group for which the review team feels that detailed study is warranted.

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, each the scope of the effort described below. The first two areas focus on specific programs; the second two concern topics that cut across programs.

A. **Resource Conservation Manager program**. The review team sampled and examined project files for five 2010 RCM projects. We found the documentation of savings to be extensive and thorough. Nonetheless, more detailed review may be justified for several reasons. First, this program accounts for a significant portion (7%) of the electric portfolio claimed savings, with each project accounting for a large amount of savings, on average. Second, 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 would be 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.

   Initially, this study will randomly select 20 of the 2010/2011 first half projects (approximately 17% precision @ 90% confidence). We will then:

- Review full project files for each sampled project, and assess how savings verification and calculation was performed,
- Categorize completed measures across projects. Select 50%of these projects for detailed interviews with RCMs and program staff to obtain more information.
- Select 25% of interviewed projects for onsite visits to collect additional data and further verify actions taken and savings achieved for key measures.

Results for each sampled site would be reported and aggregated to reach general conclusions about the veracity of 2010-11 savings from the RCM program, as well as recommendations for better verifying and documenting program achievements, if needed.

B. **Single-Family New Construction program**. The review team sampled six projects, accounting for 11 measures, out of those claimed for 2010 for this program (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 obtained for the sampled project in this development was insufficient to determine the veracity the savings, though PSE is willing to make more information available. Because of the complexity and scale of this development, and the fact that it accounts for 15-20% of the 2010 electric savings for this program, the review team recommends that we investigate the projects associated with this development more deeply. This would include meeting with the PSE program manager, and requesting and reviewing additional files for projects associated with large homebuilder.

C. **Measure installation verification, with focus on third-party programs.** 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 recommends a more thorough look at the verification procedures, particularly those concerning third-party and commercial rebate programs. This detailed review would focus 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 would differentiate between practices in place in 2010 and 2011.

E. **Targeted on-site verification**[65]**.** To supplement the file review process, the review team will visit a subset of over 200 projects to verify them through observations and customer interviews. The focus will be on the on 13 of 24 program review domains that were not covered by recent/current evaluations, and where onsite inspections likely will yield meaningful information. Using 2010/2011 first half project samples chosen for the Task 1 file review as a sample frame, the review team will employ an algorithm that accounts for (1) program saving size, (2) third-party administration, (3) measure complexity, and (4) rigor of existing inspections. For each selected project, we will review files and set up on-site verification appointment with customer. The site visit will provide opportunities to confirm as much as possible, through interviews and inspection, that measures associated with project were fully installed and operational. After as many sampled projects as possible are inspected, the review team will aggregate results and develop overall findings. Key research questions for the inspected projects are 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)?

Additional issues or complications may arise during the detailed review. For instance, if significant discrepancies are found in one area, the review team may perform the additional verifications necessary to support a savings adjustment.

[65] Study area "D" is omitted from this list, to keep the letter designations consistent with a master list of potential study topics. The "D" study was eliminated from consideration during discussions between the review team, PSE, WUTC, and CRAG.

7. APPENDICES

7.1. Excerpts from Electric Conservation Settlement Agreement

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

Excerpts from portions the Settlement that are particularly germane to this review are provided below. The header for each excerpt contains the citation and a brief summary:

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/l937/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))[66] and system cost definition (RCW 80.52.030(8))[67] 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

[66]"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.

[67]"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.

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.

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.

7.2. List of data sources

ID	Receipt Date	Data Group	Document(s), file(s)
1	March 2011	2010 Conservation report	2010 annual report (body)
2	March 2011	2010 Conservation report	2010 annual report (appendices)
3	March 2011	2011 Conservation plan	cost-effectiveness discussion
4	March 2011	2011 Conservation plan	cover letter
5	March 2011	2011 Conservation plan	evaluation budgets
6	March 2011	2011 Conservation plan	program descriptions
7	March 2011	2011 Conservation plan	savings goals and budgets by program
8	March 2011	2011 Conservation plan	Exhibit 1-2_2011 EES sector view
9	March 2011	2011 Conservation plan	Exhibit 1-3-BE 2011 EES program details BEM-Electric
10	March 2011	2011 Conservation plan	Exhibit 1-3-OE 2011 EES program details Other Electric
11	March 2011	2011 Conservation plan	Exhibit 1-3-RE 2011 EES program details REM-Electric
12	March 2011	2011 Conservation plan	Exhibit 1-3-SA 2011 EES program details Support Activities
13	March 2011	2011 Conservation plan	Exhibit 2 - Portfolio Cost Effectiveness Revised 11-19-2010
14	March 2011	2011 Conservation plan	Exhibit 4 2011+Measures-Incentives-Eligibility 12012010
15	March 2011	Regulatory docs (in RFP)	Order%2B05%2B-%2BFinal%2B-%2B100177-011570-011571
16	March 2011	Regulatory docs (in RFP)	WUTC Online Records Center Filing Docket 100177 Docket Sheet Entry
17	March 2011	RFP materials	Attchmt A - UE-100177 PSE Settlement Agreement 9-3-10
18	March 2011	RFP materials	Attchmt B - 2010 Semi-Annual Report_FINAL!_08092010
19	March 2011	RFP materials	Attchmt C - 2010-11 Eval Plans Rev11-10-2010
20	March 2011	RFP materials	Attchmt D - Savings by measure type_Jan-Aug 2010
21	March 2011	RFP materials	RFP PSE 2010-11 Elec Savings Review Final Rev 12-09-10
22	4/1/2011	IRP	FW PSE's Draft 2011 IRP Next Steps.msg
23	4/1/2011	IRP	IRP_2011_Chap1.pdf
24	4/5/2011	Master database	EES Electric Master Tracking 2010.xls
25	4/5/2011	Master database	Elect - EESPgmCE2010_Bobbi2_Final.xls
26	4/5/2011	Master database	ESS Audit Detailed Draft Report w_responses.doc
27	4/5/2011	Master database	ESS Executive Summary Draft 11gen01 3.22.2011.doc
28	4/5/2011	Master database	PSE Responses_Sch 120 filing--PC first set data requests to PSE_04042011.docx

ID	Receipt Date	Data Group	Document(s), file(s)
29	4/5/2011	Master database	Tracking and Reporting Improvements.ppt
30	4/12/2011	EM&V documentation	2007CommericalLightingStudy.pdf
31	4/12/2011	EM&V documentation	2008 Low Flow Showerhead Study.pdf
32	4/12/2011	EM&V documentation	2008 Resource Conservation Mgr Impact Evaluation.pdf
33	4/12/2011	EM&V documentation	2008ResidentialGasFurnaces.pdf
34	4/12/2011	EM&V documentation	2009 CFL Svgs Adjustmt & 2007 Market Study.pdf
35	4/12/2011	EM&V documentation	2009 Gas Boiler Tune-Up Evaluation.pdf
36	4/12/2011	EM&V documentation	2009_2010ProjectPorchlight.pdf
37	4/12/2011	EM&V documentation	2010 Residential Gas Storage Water Heater.pdf
38	4/12/2011	EM&V documentation	2010HomeEnergyReports.pdf
39	4/12/2011	EM&V documentation	2010VFD.pdf
40	4/12/2011	EM&V documentation	2011 Evaluation Organization Study 4-4-2011.pdf
41	4/12/2011	EM&V documentation	2011 PC Power Management Evaluation.pdf
42	4/12/2011	EM&V documentation	EMV 110331 DR for 3rd Party Review of 2010-11 Electric Svgs - Mailing 1.msg
43	4/12/2011	EM&V documentation	EMV 110331 DR for 3rd Party Review of 2010-11 Electric Svgs - Mailing 4.msg
44	4/12/2011	EM&V documentation	PSE C&I Custom Program Process Eval Work Plan_draft final_2011_03_17.docx
45	4/12/2011	EM&V documentation	PSE C&I Impact Evaluation Work Plan (Draft) 20110318.docx
46	4/12/2011	EM&V documentation	PSE CI Eval Work Plan_Market_Final to PSE_2011-03-25.docx
47	4/12/2011	EM&V documentation	PSE Multifamily Retrofit Evaluation Workplan (10-25-10 FINAL).doc
48	4/12/2011	EM&V documentation	RE EMV 110331 DR for 3rd Party Review of 2010-11 Electric Svgs - Mailing 2.msg
49	4/12/2011	EM&V documentation	RE EMV 110331 DR for 3rd Party Review of 2010-11 Electric Svgs - Mailing 3.msg
50	4/12/2011	EM&V documentation	Summit Blue Proposal for Puget Sound Duct Sealing_Ecos.docx
51	4/19/2011	EM&V documentation	2009 Premium Svc HVAC Impact Evaluation.pdf
52	4/19/2011	EM&V documentation	2009 Premium Svc HVAC Process Evaluation.pdf
53	4/20/2011	2010 Conservation report	2010 annual report replacement pages_cover letter.doc
54	4/20/2011	2010 Conservation report	April 2011 replacement Appendix A.pdf
55	4/20/2011	2010 Conservation report	April 2011 Replacement Appendix D.pdf
56	4/20/2011	2010 Conservation report	April 2011 Replacement Appendix F.pdf
57	4/20/2011	2010 Conservation report	FW Updated replacement pages PSE's draft of its 2010 Annual Report replacement page filing.msg
58	4/22/2011	Measure Metrics	MM_Database_Rev8.01.mdb

ID	Receipt Date	Data Group	Document(s), file(s)
59	4/22/2011	Measure Metrics	Business measures folder (numerous subfolders and files within)
60	4/22/2011	Measure Metrics	Residential measures folder (numerous subfolders and files within)
61	4/25/2011	Measure Metrics	MM_Database_Rev8.01.mdb
62	4/26/2011	BEM 2010 project data	PSE 2010 E - Business 1.xls
63	4/27/2011	REM 2010 project data	ECOS SF WX Meeting Questions.doc
64	4/27/2011	REM 2010 project data	UCONS SF Wx Meeting Questions.doc
65	4/28/2011	REM 2010 project data	E214_Refrigerator_Decomissioning.xlsx
66	4/28/2011	REM 2010 project data	Rebate_Processing_Manual.doc
67	4/29/2011	REM 2010 project data	E201_LowIncomeWx.xls
68	4/29/2011	REM 2010 project data	E214_Showerheads.xlsx
69	4/29/2011	REM 2010 project data	E214_Water_Heat.xlsx
70	4/29/2011	REM 2010 project data	E216_SF_Fuel_Conversion.xlsx
71	4/29/2011	REM 2010 project data	E217_MF_Existing.xlsx
72	4/29/2011	REM 2010 project data	E217_MF_Existing_ECOS.xlsx
73	4/29/2011	REM 2010 project data	E218_MF_New_Construction.xlsx
74	4/29/2011	REM 2010 project data	E249_Pilots.xlsx
75	5/2/2011	REM 2010 project data	Back up EFI Oct 10 1st.xls
76	5/2/2011	REM 2010 project data	Back up EFI Oct 10 2nd.xls
77	5/2/2011	REM 2010 project data	Fluid-BPS Oct 2010 invoice.pdf
78	5/2/2011	REM 2010 project data	Invoice CFL.Fixture 10.11 to 10.24.pdf
79	5/2/2011	REM 2010 project data	Invoice.Back up.CFL.Fixture 9.20 to 10.10.pdf
80	5/2/2011	REM 2010 project data	PSE - Costco Back up 10.17 to 10.24.10.xls
81	5/2/2011	REM 2010 project data	PSE-Costco sales data 9.20 to 10.10.xlsx
82	5/2/2011	REM 2010 project data	August NC Lighting Report 20100830 .xls
83	5/2/2011	REM 2010 project data	July NC Lighting Report 20100728.xls
84	5/2/2011	REM 2010 project data	June NC Lighting Report 20100701.xls
85	5/4/2011	REM 2010 project data	201001_January_2010_CRD report_PSE.xls
86	5/4/2011	REM 2010 project data	201002_February_2010_C&RD report_PSE.xls
87	5/4/2011	REM 2010 project data	201003_March_AllElectric.xls
88	5/4/2011	REM 2010 project data	201004_April_AllElectric.xls

ID	Receipt Date	Data Group	Document(s), file(s)
89	5/4/2011	REM 2010 project data	201005_May_AllElectric.xls
90	5/4/2011	REM 2010 project data	201006_June_AllElectric.xls
91	5/4/2011	REM 2010 project data	201007_JULY_2010_C&RD report_PSE.xls
92	5/4/2011	REM 2010 project data	201008_August_2010_CRD report_PSE.xls
93	5/4/2011	REM 2010 project data	201009_SEPT_2010_C&RD report_PSE.xls
94	5/4/2011	REM 2010 project data	201010_OCT_2010_C&RD report_PSE.xls
95	5/4/2011	REM 2010 project data	201011_NOV_2010_C&RD report_PSE.xls
96	5/4/2011	REM 2010 project data	201012_DEC_2010_C&RD report_PSE.xls
97	5/4/2011	REM 2010 project data	E214_Appliances.xls
98	5/5/2011	REM 2010 project data	E214_Homeprint.xlsx
99	5/5/2011	REM 2010 project data	E214_Homeprint_Bainbridge.xlsx
100	5/5/2011	REM 2010 project data	E214_SFWxEcos.xlsx
101	5/5/2011	REM 2010 project data	E214_SFWxUCONS.xls
102	5/5/2011	REM 2010 project data	E214_SFWx_Windows.xls
103	5/5/2011	REM 2010 project data	E214_Water_Heat.xlsx
104	5/5/2011	REM 2010 project data	CEC CFL DI Report 08-2010.xls
105	5/5/2011	REM 2010 project data	CEC CFL DI Report 09-2010.xls
106	5/5/2011	REM 2010 project data	CEC CFL DI Report 10-2010.xls
107	5/5/2011	REM 2010 project data	CEC CFL DI Report 11-2010.xls
108	5/5/2011	REM 2010 project data	CEC CFL DI Report 12-2010.xls
109	5/5/2011	REM 2010 project data	Re-Power December 2010.xlsx
110	5/5/2011	REM 2010 project data	Re-Power November 2010.xlsx
111	5/10/2011	Cost-effectiveness info	Copy of QC Reviewer_ReQC_2_15.xls
112	5/10/2011	Cost-effectiveness info	SBWQ's1.doc
113	5/11/2011	REM 2010 project data	E - Business 2.xls
114	5/11/2011	REM 2010 project data	E214_Space_Heat.xlsx
115	5/11/2011	REM 2010 project data	E217_MF_Existing_UCONS.xls
116	5/13/2011	BEM 2010 example files	078-7759 _____ - HVAC Upgrades.pdf
117	5/13/2011	BEM 2010 example files	080-3688 _____ Lighting Retrofit.pdf
118	5/13/2011	BEM 2010 example files	078-8314 _____& Garage).pdf

ID	Receipt Date	Data Group	Document(s), file(s)
119	5/13/2011	BEM 2010 example files	078-3482 RCM Start-Up - City of _____.pdf
120	5/13/2011	BEM 2010 example files	080-9156 SBL - _____.pdf
121	5/13/2011	BEM 2010 example files	081-0715 SBL - _____ Heating & AC.pdf
122	5/13/2011	BEM 2010 example files	080-8516 - HE Heat Pump & AC - _____ Bldg.pdf
123	5/13/2011	BEM 2010 example files	083-1928 Comm Ltg - _____.pdf
124	5/13/2011	BEM 2010 example files	081-0204 Premium HVAC - _____ Auburn.pdf
125	5/13/2011	BEM 2010 example files	082-4380 - VFD - _____ Office Commons.pdf
126	5/13/2011	REM 2007-09 example files	Various in folder "E217 MF Wx project files (from PSE15)"
127	5/13/2011	Cost-effectiveness info	E Brateng responses to CE questions.msg
128	5/13/2011	Cost-effectiveness info	Best Practices Manual - Draft rev 3.082608.pdf
129	5/13/2011	Cost-effectiveness info	Measure Cost Summary 3_29_2009.Final.xls
130	5/16/2011	Avoided cost data by end use type	2010_8760.xls
131	5/16/2011	NEEA data	NEEA - PSE 2nd 2010 Estimate MAR 30 2011.xlsx
132	5/17/2011	Cost-effectiveness info	CE Std 10-11_Electric_wo 10% cons credit.xls
133	5/19/2011	EM&V documentation	PSE MF Wx Evaluation - Final Report.pdf
134	5/23/2011	REM 2010 project data	Monthly NC Lighting Reports [11 monthly spreadsheets]
135	5/25/2011	REM 2010 project data	MFNC and UCONs data [2 spreadsheets]
136	5/27/2011	EM&V documentation	CFL_WhitePaper_20090506.pdf
137	5/27/2011	BEM 2010 project data	Scanned project files (qty. 105+121=226 pdfs)
138	6/7/2011	REM 2010 project data	Project files for SF NC (qty. 6), SF Wx (qty. 21)
139	6/8/2011	REM 2010 project data	ESG project files (14 of assorted types), WA State Conservation Working Group reports (Main, Attach. A, Attach B)
140	6/9/2011	REM 2010 project data	MF project files (168 assorted docs)
141	6/10/2011	REM 2010 project data	MF project files (2 PDF files)
142	6/16/2011	EM&V documentation	RCM_Evaluation Study_20071015.pdf
143	6/20/2011	REM 2010 project data	LIW project files (qty. 6)
144	6/21/2011	BEM 2010 project data	CI Retrofit industrial project files (qty. 7)
145	6/24/2011	BEM process documentation	2011 grant process flowchart
146	7/8/2011	REM 2010 project data	Project files for HomePrint (18 pdfs), SFE Space Heat (47 pdfs), SFE Water Heat (2 pdf)
147	7/19/2011	REM 2010 project data	Project files for clothes washers (28 pdfs + 1 spreadsheet), showerheads (1 pdf)

ID	Receipt Date	Data Group	Document(s), file(s)
148	7/20/2011	REM 2010 project data	Refrigerator decommissioning (1 pdf w/many customers)
149	7/22/2011	Cost-effectiveness info	Measure life weighting calculation (qty. 8)
150	7/22/2011	EM&V documentation	Appendix G_2010 Evaluation Studies.pdf
151	7/22/2011	EM&V documentation	EES Appendix D_2010-2011_10302009.pdf
152	7/22/2011	EM&V documentation	GuidelinesForEvaluationStudyFollowup_v2.pdf
153	7/25/2011	EM&V documentation	2006-09 EES WUTC annual reports (qty. 4)
154	7/25/2011	EM&V documentation	FourYearEvalCycle3.xls
155	7/25/2011	REM 2010 project data	Project files for multifamily new construction (6 pdfs)
156	7/28/2011	REM 2010 project data	Project files for retail lighting (19 of assorted types)
157	8/10/2011	BEM 2010 project data	Supplemental project files and general information and calculations for ESG (14 of assorted types)
158	8/24/2011	Verification information	VerificationProcesses.xls (summary of inspection approach for all Biz, Res programs)
159	8/25/2011	Verification information	Examples: small biz lighting verification forms (qty. 3) Lists of inspected sites for 2010, first half 2011.
160	8/25/2011	REM 2010 project data	Project files for 5 multifamily new construction projects (11 pdfs)
161	8/25/2011	REM 2010 project data	Example: Retail lighting program Memo of Understanding (1 pdf)
162	8/25/2011	REM 2010 project data	Examples: Res program batch cover sheets (2 pdfs)
163	8/25/2011	Verification information	Examples: Verification forms for ES Gas Boiler, Geo HP, HomePrint, HP lockout, HP water heater (5 pdfs)
164	8/29/2011	Verification information	Verification processes for MF Existing, with example.

7.3. Details of project reviews

Table 28: Details of Residential Energy Management (REM) Project Reviews

#	Schedule(s)	Sampling Domain		Reviewer Comment/Question	Response
1	E201	Low Income Weatheriza-tion		The deemed CFL lighting fixture measures for this program use a UES of 65 W/lamp, however, the only CFL fixture measures in MM for this program have a UES of 61 W/lamp	PSE relies on agencies for project details and they sometimes cannot tell if a CFL is interior or exterior, so for the 2010 program, 65 UES w/lamp was based on RTF estimate for any (indoor / outdoor) CFL fixture replacement.
2				no evidence of a pre or post inspection for any of the sampled measures	All agencies contracted with PSE perform pre-and post-inspections on 100% of measures installed, in accordance with Dept. of Commerce Policies and Procedures. PSE performs measure verifications on 15% of units completed.
3				Invoices only provided for about half of the sampled measures.	Invoices are housed in project files at the social service agencies contracted with PSE and provided to PSE if requested.
4	E214	Single Family Existing Exclude Weatheriza-tion	clothes washers	Nothing in documentation specifies what "tier" of washing machine it is and how the corresponding MM measure is determined. Neither measure incentive nor savings are listed in program documentation. Equipment cost or incremental cost is not included in program tracking. There is no evidence of a pre or post inspection. No incentive amount, check, or payment date included in documentation.	This is a PECI third-party program. PECI uses the model information on energystar.gov exclusively to qualify clothes washers and to determine their energy factors. The program does not have pre or post inspections

#	Schedule(s)	Sampling Domain		Reviewer Comment/Question	Response
5			water heat	No documentation/evidence of energy factor, simply hand written in on documentation.	PSE staff looks up Energy Star values, based on model number provided. Unfortunately, the EF for water heaters isn't readily available for customers or their contractors. It isn't in the manual or on the water heater and therefore must be looked up. PSE performs an eligibility verification and selects measures from approved choices in CSY. Database line item data contains more important rebate information--such as paid dates and claimed savings--than the paper files.
6			HomePrint	okay	
7			refrigerator decommis-sioning	Documentation is very sparse, simply the address with a brief description of the equipment. Program rules do not specify whether equipment should just be removed or if it can be replaced. Do/should personnel confirm that equipment won't be replaced?	PSE runs program in accordance with regional specifications. PSE Program specifications require that the decommissioned refrigerator is a secondary refrigerator (not primary) and that it is running. The RTF savings value of 905 W that this program uses assumes a certain % will be replaced.
8			residential EE lighting rebate	Documentation includes invoice with fixture count, rebate to retailer and in some files a "back-up" file with list of retailers, fixture & CFL count and rebate. Actual rebate for fixtures ($12/unit) differs from MM value ($12.5/unit), and for CFL's the average rebate ($1.1 to $2.4/CFL) varies from MM rebate ($3/CFL). Do the retailers have a list of the unit markdown (rebate) per specific CFL from PSE that they adhere to?	MM incentive = maximum incentive/measure, however, lighting has a range of incentives based on type - retailers have exact markdown amounts

#	Schedule(s)	Sampling Domain		Reviewer Comment/Question	Response
9			showerheads	No incentive - kit mailed to customer. Costs not provided in documentation or program tracking. No evidence of pre or post inspection or installation verification.	PSE does not conduct pre or post installation verification. They have in the past conducted a customer evaluation to determine the install rate of 76%, which is why they do not use the RTF savings number that uses an install rate of 67%, but a modified RTF PSE-modified savings number.
10			space heat	Documentation sparse with rebate hand written in and no incremental cost or energy savings information provided. In the measure list in the application where they mark the system type, could include the updated MM incentive amount and energy savings value corresponding to each measure to make it more traceable to the program tracking. No incentive checks or payment date included in documentation. Ductless heat pump MM savings (3950 kWh) do not match claimed values (3500 kWh).	PSE rebate calculation team get the HSPF factor from certificate of product rating and select the corresponding measure type from a list that provides the corresponding incentive and savings values. DHP savings updated from 3950 to 3500 in the program tracking. This is an example of a year-to-year correction, where the former value remains valid since the project was begun in that year.
11	E214	Single Family Existing Weatheriza-tion		For all window measures, the window area is calculated by hand and rebate and area are hand written in on the application. Also, no incentive checks are provided with the payment date. No evidence of pre or post inspection or description of pre-existing window type.	Window Sq Footage calculations are done by rebate processors to confirm reported square footage by the customer

#	Schedule(s)	Sampling Domain	Reviewer Comment/Question	Response
12			It would be useful if they listed the measures with their current incentive and energy savings in the rebate application and checked which measure they are installing - or had some way of tracing the program tracking incentive and savings back to the MM record, rather than just hand writing the values on the documentation.	See PSE General Process Overview below
13			Why is it required that house be fully insulated in order to qualify for the rebate? How is customer supposed to provide proof?	PSE requires the home be fully insulated to drive the installation of more cost effective weatherization measures before a customer installs windows. Windows are one of the most expensive weatherization improvements, with often much longer pay back periods than insulation, duct sealing, etc. Window installer must be licensed, bonded, and insured contractor and verification of eligibility (insulation levels) is confirmed by installing contractor. Post installation QA is provides additional verification.
14	E215	Single Family New Construction	The energy saving just hand-written in, no traceability to MM record.	This program features instant discounts at the point of sale by distributor and PSE gets invoiced by them at the end of the month with totals. PSE does in-house inspections of lighting for 15%. Total count of fixtures is the key, Washington State Energy Code requirements for new construction only allow only claim/rebate for interior lights, so EUL is automatically 61 W/fixture and 33 W/lamp.
15			Refrigerators, washing machines & whole house fans: poor documentation - many sites lumped together in a single table and the correct measure type does not carry through the documentation to the program tracking for the single site sampled.	Documentation received was a sample for one month, which comprised 15-20% of the entire project. This was an uncharacteristically large, one-of-a-kind project with a major homebuilder. PSE developed a system with monthly reports on eligible devices, which they acknowledge did not work out well, so they have adopted the Energy Star System as to 12/2010

#	Schedule(s)	Sampling Domain		Reviewer Comment/Question	Response
16			*	SF New Construction (E215) – some measures are missing IMC field so do not have a customer cost. o 2008-2009 Dishwasher Gas WH .65-.67 EF o 2008-2009 ESH Dishwasher Any WH .65-.67 EF[BH3] o Whole-house fan	Missing customer cost fields may be exist because gas savings are a significant portion of the measure savings claims for certain measures, and so the costs are allocated to gas. Specifically for whole house fans, the incentive exceeded the incremental measure cost..
17	E216	Single Family Fuel Conversion		Where do the deemed values from this program come from as there are no MM deemed records for E216?	None needed. Review team found appropriate values under Gas measures.
18				It would be useful if they listed the measures with their current deemed incentive and energy savings in the rebate application and checked which measure they are installing - or had some way of tracing the program tracking claimed values back to their source in MM or otherwise, rather than just hand writing the values on the documentation.	PSE rebate calculator people look up customer and usage in order to determine their qualifying "tier", then the corresponding measure and tier is selected from a list with the incentive and savings provided.
19			*	Project no. 809299, costs seem to be too high.	Data for this project was provided to the review team - costs for the project were recorded incorrectly - reported whole project cost instead of the measure cost
20	E217	Multi Family Existing		For CFL's, claimed UES matches MM value (33/unit), but current MM incentive ($6.50/unit) does not match claimed value ($8.93/unit). Also, no invoice or incentive check is provided.	This was a direct-install measure, so M:M and incentive checks are irrelevant. The $8.93/unit is the contractor cost (equip + labor), not the incentive.

#	Schedule(s)	Sampling Domain	Reviewer Comment/Question	Response
21			For common area lighting, the Small Business calculator is used, is this intentional? Also, sometimes the 2008 calculator is used instead of one of the 2010 versions.	Common areas in a multi-family dwelling are modeled as businesses, so the Small Business calculator is used for this. The year of the calculator is the year when the project started and some projects span several years.
22			For pipe wrap measures, UES matches MM value, but current MM incentive ($5/unit) does not match claimed value ($4/unit) and there is no source of savings or incentive information provided in documentation - only a tally sheet of DI measures.	This was a direct-install measure, so M:M and incentive checks are irrelevant. The $4/unit is the contractor cost (equip + labor), not the incentive.
23			For showerheads, MM incentive = $0/unit, but incentive claimed in program tracking = $16.5/unit - is this supposed to be the value of the showerheads? No invoices or source of savings or incentive information provided in documentation - only a tally sheet of DI measures.	This was a direct-install measure, so M:M and incentive checks are irrelevant. The $16.5/unit is the contractor cost (equip + labor), not the incentive.
24	E218	Multi Family New Construction	The 08-09 Energy Star deemed CFL light fixture measures for this program use a UES of 64 W/lamp, however, the only CFL fixture measure in MM for this program has a UES of 61 W/lamp. Is this a retired measure and if so, why is it included in the 2010 program?	A project is claimed and paid based on the defined savings and incentive of the year when the project was started - so for projects begun in 08 or 09, the 08-09 EUS of 64W/fixture is correct.

#	Schedule(s)	Sampling Domain	Reviewer Comment/Question	Response
25			For the single commissioning measure sampled, the documentation is incomplete with no analysis or source of savings information provided.	Commissioning is a custom measure and a PSE provided a CD containing 2 binders worth of supporting data to SBW. Analysis or source of energy savings information is contained within the commissioning program. PSE documentation shows eQUEST used for the whole building electric measures. The commissioning grant was based on a percentage of the cost of commissioning and meeting specific PSE requirements for the grant. It appears pretty thorough and satisfies reviewer request.
26			For corridor lighting reduction measures, calculator not provided for 2 out of 3 sampled measures and old calculator used (2008) for the 1 included.	Additional documentation was provided to review team.
27			For Energy Star refrigerators, calculator only provided for 1 out of 4 sampled measures, no invoice, source of UES or Incentive values provided for the remainder.	Additional documentation was provided to review team.
28			For Garage Lighting reduction, calculator provided for 1 out of 2 sampled measures and the other has no source of savings information provided. Also, no invoices provided for either measure.	Additional documentation was provided to review team.
29			For single whole building electric measure, the documentation incomplete with no analysis or source of savings information provided.	See response to #25.

#	Schedule(s)	Sampling Domain	Reviewer Comment/Question	Response
30			For windows, old calculator used (2008) and the current MM incentive ($4/sqft) does not match the claimed/calculator incentive ($1.55/sqft).	The year of the calculator is the year when the project started and some projects span several years. MM incentive of $4/sqft was a mistake and has been retired in the database. $1.55/sqft is the correct value.
31	E249	Pilots	okay	
32	GENERAL		What is the distinction between programs that require a pre/post inspection and those that do not? Is there any random inspection for non-inspected programs/measures in order to ensure measures are installed?	Inspections: Contracted third-party inspections. In-house inspections are by random selection, with calls and home visits. Inspections are tracked in a DB. The QA Team was really established in 2011, so only the HomePrint program was subject to QA Team work in 2010. Their inspection focus is based in "rate of return" considerations, aimed towards areas of risk.
33			Why don't many of the programs keep a copy of the incentive check and/or equipment invoices in the file?	REM is high-volume, so checks do not go back to program managers, unlike BEM, where PMs often personally deliver checks to customers. As a result, check copies do not get back to the project files. In general, PSE is trying to move away from checks to direct deposit to reduce costs. Batch dates should be in CSY, paid date in third-party data. PSE noted that CSY has a Dec. 25 cut-off date, and PMs are instructed not to try to "back-load" lots of projects at the end of the year.

#	Schedule(s)	Sampling Domain		Reviewer Comment/Question	Response
34				Is there a way to link the MM deemed values to the documentation and program tracking database? -Either by including the current list of MM options with savings and incentive in the application and selecting the measures that apply or linking the program tracking data to the corresponding MM record by a unique ID, rather than having to match the measure by name.	BEM data through CSY; REM data through CSY for in-house programs, different data streams for third-party programs. Currently no tie between M:M (Andy) and DB (Steve), but PSE hopes to have this functional by the end of 2011. Among the key improvements to data processing PSE plans to make soon are: (1) linking the DB and M:M, (2) standardizing third-party program data, so that it can go directly into the DB, (3) developing consistent measure naming, and (4) creating better ways to flag corrections.
35				Are current year calculators (2010 in this case) always supposed to be used for energy savings, or do older versions carry over unless a new version has been created? In some cases the Small Business calculator is used for multi-family, is this acceptable?	The calculators used vary depending on when a project was signed up. A long lag can exist between when a calculator is first employed on a project and when the project is complete. PSE uses the calculator that was originally agreed to with the customer. Other program calculators can be used as appropriate, if they have useful assumptions and bases for estimating custom savings.
36				Why isn't cost information carried through to the program tracking database for the majority of residential programs?	Many of the programs are run through third-parties, who receive a single large check to cover many individual projects.
37			*	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.	Actual measure costs were used in instances where deemed incremental measure costs were not available.

#	Schedule(s)	Sampling Domain	Reviewer Comment/Question	Response
PSE General Responses to Reviewer Comments and Questions				
a.			The review team provided PSE with a number of comments and questions resulting from their documentation review for electric savings claims from Residential programs in 2010. Many of these questions followed a common theme. Attached is PSEs response related to these general themes.	
b.			Each residential program within EES has a specific suite of "measures" they promote to PSE's customers. These programs offer incentives to their customers who install these energy saving measures in their homes. PSE counts savings for these measures when the customer is paid an incentive (rebate) for a particular measure. Nearly all of the measures offered by residential programs have a "prescriptive" savings value. That is, PSE claims a particular savings amount (in kwh or therms) for each measure they have provided our customers and incentive to install. For example, in 2010 our Electric Space Heat program claimed 507kwh for every Tier 1 Energy Star Heat Pump rebate paid to customers during that year.	
c.			EES has developed a Tracking and Reporting System (EES Tracking Database) for program managers to track and report their savings for all the measures offered by their program. Within this database system, each measure assigned to a particular program has an assigned savings value that is used to calculate program savings. These savings values are matched with those reported in the Measure Metrics database to ensure reporting accuracy. Each month program managers report the activity for each measure offered under their program. These program managers track the units for each measure rebated during a given month. The database system calculates the savings for each program based on the units reported and the measure savings value contained in the database.	
d.			Documentation for each measure tracked by a program typically consists of an invoice/receipt that the PSE customer has provided as evidence that they have installed a particular measure in their home. This invoice may also be accompanied by a rebate application which provides the terms and conditions for a particular program. PSE does not include the savings value they claim to the UTC for a particular measure on any of its rebate application. The savings values claimed by PSE represent only first-year savings and are estimates of average first year savings that a customer would receive. Providing this value on rebate forms would potentially be misleading to PSE customers. Additionally, these savings values are updated from time-to-time which would result in constant revisions and reprinting of rebate forms. NOTE – PSE provided a detailed project/measure tracking that tied to the files. Measure details are contained in the tracking – not in the files. For rebates, typically only the "widget" documentation is in the files.	
e.			There are two important verification steps for every rebate PSE pays. First they must ensure that the measure being rebated is to a PSE customer and that the residence where the measure is installed is in their service territory. For electric saving measures the customer/residence must be a PSE Electric customer, and likewise for gas savings measures. The second critical verification step that every rebate undergoes is verification that the equipment installed meets the requirements of the given rebate. Rebate processors check each and every invoice supplied against qualification requirements for that particular piece of equipment. Some of the residential programs employ third-party service providers who promote, deliver and provide rebates to their customers. These service providers provide this same level of customer and equipment verification for rebates they are contracted to provide.	
○			Measure Metrics: General purpose of M:M is to provide documentation to back up deemed savings. Recently, this purpose has been expanded to also track measure life, historical information, and incentive levels. It is important to note that the programs are "real-time," while M:M is always trying to keep up with programmatic reality. In 2008, measure data formerly maintained by individual program staff were compiled and archived in an Access database, creating M:M in its current framework. Since that time, M:M has been regularly enhanced.	

#	Schedule(s)	Sampling Domain	Reviewer Comment/Question	Response
			○ Claimed dates: Always a lag time, particularly for projects that take a while to develop. Therefore, a project begun in 2008 might establish savings and incentive levels with a customer based on what was applicable at that time, but the project savings might not be claimed until 2010 when the project is fully completed and inspected. PSE counts project savings in the year paid, consistent with UTC accounting protocols.	
			○ Eligibility of customers and products - this is an important element that PSE takes pains to verify.	

*Determined from Task 3 incremental measure cost/cost effectiveness review.

Table 29: Details of Business Energy Management (BEM) Project Reviews

#	Schedule(s)	Program		Reviewer comment/question	PSE response
1	E250	C/I ESG	*	C&I retrofit does not include measure costs implemented by PECI's Energy Smart Grocer Program.	The measure cost for Energy Smart Grocer projects was previously not tracked in the CSY database. Additionally, due to the linking between accounts payable and CSY incentive payment values are not tracked in CSY. This data is tracked separately in a report provided by PECI and was used in PSE's 2010 Cost Effectiveness Analysis.
2				Unclear in project files how savings, costs, and incentives are calculated.	Savings are calculated using deemed and deemed calculated savings from the Grocer Smart Software. Incentive calculation is based upon a prescriptive calculation and is detailed on the Energy Smart Grocer incentive cover sheet. Measure costs are based upon customer submitted invoices.
3				No evidence of inspections in project files.	PECI performs the inspections and reports to PSE. This information is tracked on the PECI form labeled "post installation rebate checklist." This is the post installation inspection form used by PECI Field Energy Analysts to verify installations.
4	E250, E255, E262	C/I Lighting		3 CFL measures where the wrong wattage was entered in the tracking DB, so that it does not match the Measure Metrics (M:M) wattage (the savings and incentives are correct, though).	There is due to an old measure code that is very similar in appearance to the current one. The current one has a "deemed savings" amount of 155 kWh and the old measure code requires the person inputting the project to manually type in the savings. Also, the old rebate amount for CFLs greater than 26 Watts was once $3. This is why, even though the measure code is incorrect, the savings and incentives are correct. Recently PSE required all contractors with projects older than 6 months to be resubmitted for pre-approval. This eliminates the need to

#	Schedule(s)	Program		Reviewer comment/question	PSE response
					keep very old measure codes on the books and a purge of measure codes for measures that have been updated.
5				Numerous cases where vendor cost is the same as the incentive. Why is this? (this is similar to the comments under E262 Commercial Rebate excl Ltg)	This happens because there is no cap on the percentage or a project a rebate can pay, so the contractors have lowered the equipment cost to provide it at "no-cost" to the customer. This is only available for small business applications and is very common in this program for numerous measures.
6				4 instances with apparent data entry errors or numerical discrepancies.	The records are correct in the CSY data provided by PSE. When the review team combined program data to develop the sample frame, several records were inadvertently merged.
7	E251	C/I New Construction		For new construction, baseline measured data is not available, so analysis defaults to code baseline conditions, with measuring performed after installation.	
8				2 minor M:M discrepancies	Custom grants use custom analysis. If a M:M measure is appropriately suited for a custom grant measure, M:M values from a similar program may be used.
9	E250	C/I Retrofit HVAC/Oth		None	
10	E250	C/I Retrofit Ind/Proc		None	
11	E262	Commercial Rebate excl Ltg	*	Some items do not have any costs but include savings (e.g., project ID 812694). Twenty out of 26 projects, with the $3 < 26 watt lamp measure. do not include costs.	Some programs use contractors to deliver measures directly to customers. PSE has an agreement with the contractor to pay them directly in one payment for multiple instances of the measure or measures. The contractor is reimbursed through an invoice payment. In order not to count this cost twice, it is accounted for in the invoice payment, but is still

#	Schedule(s)	Program		Reviewer comment/question	PSE response
					direct benefit to customer. Savings are accounted for in the same manner as in other programs but show no cost.
12			*	Contractor bonus or sales incentive/ spiff is assumed to help buy down customer costs. These incentives are included in the program aggregate total measure cost.	Yes. Spiffs have their own measure code in order to separate them from the incentive amount.
13			*	In some cases, measure costs are equal to rebate amounts. It seems that the assumption was that the IMC is equal to the rebate, the invoice is not detailed, or there was a recognition that full measure cost was not supposed to be used. The following items denote where this was found:	
14			*	1. Project ids 809110-8019112 for dishwasher rebates.	When gas and electric are on the same dishwasher project the measure cost is shared between both. The bulk of the measure cost is attributed to the fuel used for water heating because that is where most of the savings comes from. If the same fuel is used for the booster heater as for the water heater this does not occur *[Reviewer note: The concern still exists that the cost should still be allocated at least partly to electric for C-E calc purposes.]*
15			*	2. 7 out of 10 $150 Under counter high temp	When gas and electric are on the same dishwasher project the measure cost is shared between both. The bulk of the measure cost is attributed to the fuel used for water heating because that is where most of the savings comes from. If the same fuel is used for the booster heater as for the water heater this does not occur.

#	Schedule(s)	Program		Reviewer comment/question	PSE response
16			*	3. Several Comml CFL Mark Down Program $3 measure do not have a customer payment.	These are paid to the contractor. These contractors take the customer incentive off at point of sale.
17				4. All $30 under counter or door type	This is a dealer spiff.
18				5. All $350 door type, high temp	See response to Comment #14.
19				6. Some $40 and $80 ltg controls rebates have no customer payment.	This happens when there is not enough controlled load to qualify for the rebate. (between 100 and 200 or over 200, if the load is <100kW, then PSE does not pay an incentive.)
20			*	Pre-rinse spray head program (implemented by a third party) does not have any incentives or measure cost.	Some programs use contractors to deliver measures directly to customers. PSE has an agreement with the contractor to pay them directly in one payment for multiple instances of the measure or measures. The contractor is reimbursed through an invoice payment. In order not to count this cost twice, it is accounted for in the invoice payment, but is still direct benefit to customer. Savings are accounted for in the same manner as in other programs but show no cost.
21			*	Project nos. 836551 and 836552 have the same measure name ($150 Electric EGP Retrofit Tier 2), grant amount ($1500), customer payment ($10,973.33) and total measure cost($12,473.33), but different kWh savings (2600 and 1940, respectively).	If the unit being replaced is not the same between two businesses, even though the unit going in is exactly the same the savings will be different. In this case project 836551 used a baseline unit of a gas pack without an economizer but did have a programmable thermostat. Project 836552 was very similar but did have an economizer. See table on tab " HPAC clarification". This particular table is for Retail >65000 btu/hr units. There are similar tables for <65000 btu/hr and for other business types.
22				For most of the "calculated" sampled sites, there is no evidence of a pre or post inspection. Is this	For most rebate programs an inspection is not necessary/required - an invoice w/the model #

#	Schedule(s)	Program		Reviewer comment/question	PSE response
				required or expected for this program?	is enough to confirm that the equipment has been purchased and qualifies for the program. 10% of sites inspected by QA team. PSE has a relationship with the commonly used contractors and they are trusted to comply with the regulations.
23				None of the sampled sites provide measure cost in program tracking, but they do provide measure cost in the program documentation, either through invoices or PSE documentation. Why is this information not carried through?	It was not a detail PSE decided to capture for this "at a glance" tool. They can get this information through CSY when needed. It may be added to CMS when it takes the place of their tracking spreadsheet.
24				for Project No. 821465, the invoice provided is for complete renovation and does not provide the itemized cost for the individual measures.	
25	E258	High Voltage		1 project lacking invoicing, counts not jibing.	For custom lighting projects, they do not track fixture count because project can include several types of lights. Also, custom grant lighting project require a light load calculator, but invoices with matching fixture counts not required - invoicing is not a method of verification of the measure, but only of the cost.
26	E257	LED Traffic Signals		There is no evidence of a pre or post inspection for any of the LED Traffic Signal sampled sites. Is this required or expected for this program?	Program inspected through random sample (10-25%) of sites (verification not documented in project file) and through an evaluation of the program.
27	E253	RCM	*	RCM program – it is unclear how values are assessed. There are some projects with claimed savings but no costs. Clarification about the process of determining measure costs assessment would be helpful. It is understood that the amount of a grant helps subsidize the RCM value if the RCM does not achieve enough savings. However, this assumption is not clear, since the measure costs are not mapping that	Projects are three-year agreements. grants are paid based on completion of deliverables, not always directly tied to verified savings, but each year there is a "true-up" where actual savings are calculated. Over the course of 3 year, consider that there may be PSE program changes and changes in customer's staff or priorities, all of which can impact how a project is completed. Program mechanics are also not

#	Schedule(s)	Program	Reviewer comment/question	PSE response
			way.	included in project files; all assumptions are documented and available, but were not provided because it was too much information to review given the SBW scope. -Some costs are shown as zero due to the nature of the measure (for instance, at the outset, a software program is provided to the customer and there is a savings associated with the use of it but no cost).
28			Generally in the 6 sampled project files, the savings calculations lack detail, allowing for significant uncertainties in the actual savings from the program. Weather adjustments to savings can be somewhat arbitrary--applied to one building, but not to others in the same area.	Site-level details are stored in program files both electronically and hard copy; in the past, only a summary sheet was included with payment/verification to reduce size of file. This practice has changed and PSE now includes all site-level calculations. Weather adjustments are applied based on valid statistical correlations as determined through a multi-variable linear regression. Not all energy consumption is weather dependent; it is not uncommon for one building to have kWh correlate to weather (heat pumps) and another not (gas boiler).
29			In the 6 sampled project files, the documentation of how incentives were calculated is poor. We encountered two cases where the grant amounts were zero.	RCM incentives are prescriptive and determined based on customer base-load. Each year's savings has multiple measures to allow flexible accounting of a three-year program. The calculations are fully disclosed in a calculation sheet that is stored in program files both electronically and hard copy and are now being included in project files. Grant amounts can be zero for salary guarantees which are placeholders for year-end true ups; or can be zero for software measures as PSE transitioned from a pay-per-customer strategy to a contract where all licenses are paid annually.
30			No evidence of inspections. Program staff just	Inspections cannot be done at all sites and on all

#	Schedule(s)	Program	Reviewer comment/question	PSE response
			QCed billing analysis.	measures due to the large volume. Therefore, RCM reports are reviewed and, if necessary focus is placed on certain sites/measures. Program managers meet with customers on a regular basis to assess progress. RCM actions are documented through a variety of methods including policies, procedures, facility action plans, interval data, site inspections, education and awareness campaigns, training, etc. QC'ing analysis is the final step - program staff does not claim savings if there is no evidence of actions taken to achieve said savings.
31	GENERAL		We would like to find out more about the inspection and verification procedures (beyond invoices) in general for the various programs.	For custom projects, PSE is involved through entire process and all sites have pre and post inspection. For small business lighting, PSE inspects between 10% & 13% of all projects. If a franchise installs a measure at multiple locations, PSE will inspect a few and then have the business provide evidence of installation at remaining sites, e.g. before and after photos. For rebate and point of sale CFL programs, the verification is invoice driven, but PSE does perform a random inspection of sites.

*Determined from Task 3 incremental measure cost/cost effectiveness review.

7.4. Details of M&V report review

Table 30: 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 39,777 households in group to participate in program with remainder acting as control group of non-participants
D	E249 - Pilots / Prescriptive Duct Sealing and Repair Pilot Program	2010-2011	Impact	Duct Sealing	Summit Blue Proposal for Puget Sound Duct Sealing_Ecos.docx	Summit Blue	NA	1. Quantify savings from duct sealing measures. 2. Assess the quality of duct sealing projects. 3. Construct a database of site-specific information collected from field activities. 4. Provide duct leakage reduction energy savings estimates. 5. Make recommendations for program improvements.	Fieldwork activities to capture pre-post-data fro the 2010/2011 heating season. This will be used to calibrate a full billing analysis.	Appropriate models of savings will be used to stratify the sample for on-site data collection.
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.

ID	Program(s) studied	Program years	Aspects addressed	Study	Document	Evaluator	Report date	Scope/Objectives	Research Design	Sample Design
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
H	E250 - C/I RetrofitE251 - C/I New ConstructionE255 - 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 Conservation 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 30: 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.	N/A	
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	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

ID	Data Collection Methods	Data Analysis Methods	Recommendations	ERR Summary	Review Comments/Observations
	participant group.				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.
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	Gross: calculating energy savings through facility operational hours, lighting fixture counts, and lighting wattages based on phone and on-	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	Small Business: no changesNew Construction: - established prescriptive savings estimates via whole building energy modeling for	In Sample Design, concluded that should be error ratios higher for SB than C&I Retrofit, but used the same

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	with spot-watt readings, time-of-use lighting loggers and true RMS power loggers.	site survey dataNet: develop NTGR from free-ridership which was estimated with customer self-reporting.	was an over-estimate of hours of use. 12. For the CNC program, separate savings by LPD reduction and controls savings. 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.	three major building types (schools, offices, retail) based in industry standard operation hours.- for custom projects, 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.	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.
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 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	See 2007 RCM process study.

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				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 to determine savings.	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.	
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	

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				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 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.	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 years for Retail Rebate and Direct Install CFL Bulbs.	2009 CFL Savings Adjustment Whitepaper not included

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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 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	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 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	

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			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.	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.	