Attachment 5:

PSE Biennial Electric Conservation Achievement Review (BECAR)

Plus

SBW Correction Recomendation

May 30, 2014

PSE PUGET SOUND ENERGY
The Energy To Do Great Things

PUGET SOUND ENERGY
2012-2013 BIENNIAL ELECTRIC CONSERVATION ACHIEVEMENT REVIEW (BECAR)
FINAL REPORT

Submitted to

PUGET SOUND ENERGY

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

Submitted by

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May 19, 2014 (FINAL)

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Additionally, Juliana Williams at the Washington Utilities and Transportation Commission, and members of the Conservation Resources Advisory Group provided valuable guidance throughout the process.

EXECUTIVE SUMMARY

Introduction

The Washington Utilities and Transportation Commission issued an order in 2012 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 independent reviews of electric savings reported by PSE for each biennium (referred to throughout this document as Biennial Electric Conservation Achievement Reviews, or BECAR).

The 2010-2011 BECAR was performed by SBW Consulting, Inc. (SBW). In general, the first biennial review verified that PSE's 2010-11 savings claim for the portfolio was sound, defensible, and well-documented. From that process, stakeholders suggested developing more clarity about the scope of future reviews, and hired industry experts to advise stakeholders about scoping of the 2012-2013 BECAR. Recommendations from their report substantially informed this current effort.

PSE retained a BECAR consultant team, consisting of SBW, in conjunction with DNV GL and Research Into Action, to carry out the 2012-2013 BECAR under the direction of PSE and WUTC staff, with further input and oversight provided by the CRAG. This report, which builds upon the 2012 BECAR Interim Report and the 2013 Interim Memo, provides a final documenting of the methodology, findings, and conclusions from the BECAR effort.

Objectives

The primary purpose of this BECAR is to assess the extent to which the electric energy savings that PSE reported for their electric conservation portfolio in the 2012-2013 biennium were achieved. This review is limited to those existing electric conservation programs that PSE operated in 2012 and 2013, and that were the basis for the electric energy savings PSE has reported for that two-year period.

The three corresponding objectives of this review are as follows:

- **Portfolio Savings Review**. Determine the veracity of total portfolio electric energy savings reported by PSE, relative to the targets and baselines established at the time of program approval by the Commission, or revised via annual updates. This includes verifying that both RTF deemed and non-RTF-derived measure savings are being applied consistent with the Settlement.
- **Cost-effectiveness Calculation Review**. Audit cost-effectiveness results, including reviewing the methodology, inputs, and calculations, to determine if it is consistent with the Settlement.

- **Future Improvements in Savings Estimation.** Suggest improvements to the programs' savings estimates for the next biennium based on findings from recently completed evaluations, original research carried out as part of the BECAR study, or secondary information sources. PSE will consider these findings when making future program improvements.

Methodology

The BECAR process commenced with development of a prioritization plan, and once that was approved, a workplan that operationalized the former. Both plans were consistent with the recommendations from the industry expert report[1]. We performed the BECAR review of the 2012 program year as a series of six tasks laid out in the workplan, namely: (1) Regional Technical Forum (RTF) deemed savings review; (2) PSE deemed savings review, (3) surveys and on-site inspections, (4) reviews of impact evaluation results, (5) direct assessment of residential lighting savings, and also (6) a cost-effectiveness assessment. The approaches for each element are summarized below:

RTF deemed savings review

For prescriptive measures with unit energy savings (UES) based on RTF values, we accepted the approved RTF values without further review. Our analysis was limited to verifying that PSE applied appropriate values to develop their savings claim.

PSE deemed savings review

For prescriptive measures with UES values developed by PSE, we examined relevant supporting documentation in the applicable version of Measure Metrics (PSE's database for tracking current and retired deemed measures). The review was applied to measures whose savings accounted for 90% of the PSE deemed savings in the 2012 and 2013 savings claim. We also compared the PSE supporting documentation to relevant documentation from prior studies and efficiency program development throughout the country; with special emphasis on studies that were relevant to conditions in the PSE service area. During the review, the review team coordinated with PSE and WUTC to establish working definitions of *corrections* to be applied retroactively, and *adjustments* to be applied in future years, and applied this framework to the review findings for PSE UES values.

Surveys and on-site inspections

Per the sampling scheme developed in the workplan, we conducted site inspections on a sample of participants in each program. The site inspections were used to assess whether PSE reported projects and measures accurately, whether they were program-eligible and operational, and whether any issues found pointed towards more systemic concerns that could lead to additional investigation. The data collection options included phone surveys, site visits

[1] *Advice on the Appropriate Scope of an Independent Third Party Evaluation of the 2012-13 Electric Conservation Program Portfolio,* Schiller Consulting and CAD Consulting, November 2, 2012.

to confirm measure implementation, site visits to confirm past inspections by others (such as PSE's verification team, or V-team), and meet-ups to accompany program inspectors in real time. The review team, in consultation with PSE and the WUTC, made slight adjustments to the sampling scheme to reflect actual project counts and findings to date. Ultimately, the review team completed 246 on-site visits, split nearly evenly between residential and non-residential facilities.

Reviews of impact evaluation results

Whenever possible, we based all or part of the review of each program on an assessment of the results from a recent PSE impact evaluation. We conducted interviews with relevant PSE program and evaluation staff to ensure that we had a full understanding of the basis for the evaluation, as well as to assess changes that have occurred to the programs since the evaluations were completed. We compared the methodology used in each evaluation to industry best practices.

Direct assessment of residential lighting savings

We performed an independent assessment of the savings associated with the upstream residential lighting program. The upstream program has two components: retailer mark-downs and giveaways of CFL and LED lamps. The scope of this effort included the following: (1) determining the proportion of lamps that were purchased and installed by non-residential customers through a telephone survey of the 50 largest participating lighting retailers, (2) reviewing PSE UES values for CFL giveaways and LED lamps, (3) estimating UES values for non-residential CFLs and LEDs, and (4) verifying installed lamp counts documented in the PSE tracking database.

Cost-effectiveness assessment

We examined the methodology, inputs, and calculations used to determine portfolio and program cost-effectiveness, in order to assess whether they were consistent with the terms of the applicable WUTC order. The order establishes the standards that PSE must use in its reporting for its programs and portfolio's cost-effectiveness. Building off the previous 2010-11 BECAR, we compared PSE's calculation methodology to the Northwest Power and Conservation Council approach, performed due diligence reviews of the calculations, and determined if PSE is in compliance with the above-stated conditions.

Findings

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

RTF deemed savings review

For all prescriptive measures with unit energy savings (UES) values based on RTF values, we found that, without exception, PSE selected the correct RTF deemed value and entered it properly into the tracking database. Consequently, we found no problems in this area, and we concluded the selected values were appropriate for developing their savings claims.

PSE deemed savings review

Our review found that PSE selected the correct PSE deemed value for each measure, and entered it properly into the tracking database. The review team did find reasons to recommend adjustments to several PSE UES values concerning lighting, HVAC, and appliances, applicable in subsequent program years. Most of these recommended adjustments are based on the premise that PSE deemed savings values should track as closely as possible to new RTF deemed values. We also found one residential heat pump measure and two residential LED measures where we feel corrections to the 2013 claimed savings are warranted.

On-site inspections

On-site inspections did not uncover any significant issues with measures not installed as documented, or with the inspection practices of the V-team, third-party implementers, or PSE engineers. An important finding of this effort was that, based on the sample of their projects that we examined, the PSE V- Team inspections are thorough and effective at ensuring project quality.

Across the 129 residential and 117 non-residential sites visited, we did not find any significant issues, where, in the review team's judgment, the problem indicated a systemic issue that warranted a correction to claimed savings.

Reviews of impact evaluation results

Generally, we found that PSE has made much progress on evaluation practices since the last biennial review, but there is still room for improvement. While we did not find any evidence which indicated incorrect results in the evaluations, we frequently felt that we had insufficient information to draw definitive conclusions. We observed the quality of evaluation, or at least evaluation reporting, to be inconsistent, even when performed by the same evaluator. Furthermore, our review noted a pattern of rejecting evaluation results that suggested lowering saving values, particularly among the residential programs. In these instances, PSE stated that they did not agree with the methodology used to derive the savings; however, we found that the evaluation methodologies in question followed the agreed upon scope of work. Our review found no evaluation outcomes that would require retroactively correcting savings claims in the 2012-2013 biennium. Going forward, PSE can continue improving evaluation practices by more closely collaborating with their contracted evaluation teams to ensure satisfactory evaluation methodologies which follow industry best-practices prior to signing off on scope of work then require consistent, high quality documentation of evaluation activities to ensure confidence in evaluation results.

Direct assessment of residential lighting savings

We performed a top-level assessment of the savings associated with the upstream residential lighting program. This is a key program, which includes two upstream components: retailer mark-downs and giveaways of CFL and LED lamps. The main portion of our direct assessment effort focused on determining the proportion of lamps that were purchased and installed by non-residential customers. The review team's surveys of the 50 mark-down retailers in the residential lighting program with the greatest sales in 2012 provided basis for estimating the percent of total program sales that was non-residential. After analyzing the results for

reasonableness, and extrapolating results to the entire program, we determined that reasonable estimates for the program were 17 percent non-residential for CFLs and 20 percent non-residential for LEDs.

Cost-effectiveness assessment

Regarding cost-effectiveness, the BECAR found that PSE has met all of the Order requirements except for minor differences with Council methodology regarding use of hourly annual avoided costs, inclusion of fewer load shapes, and exclusion of non-energy benefits and O&M costs.

Conclusions and Recommendations

The BECAR effort has yielded a comprehensive assessment, as required by the Order, of PSE's electric efficiency portfolio claim for the 2012-13 biennium. This effort combined reviews of unit energy savings, project files, impact evaluations, and cost-effectiveness calculations, coupled with extensive on-site visits and interviews with PSE staff, to develop the following conclusions regarding the three study objectives. Conclusions and recommendations for each of the objective areas—portfolio savings, cost-effectiveness calculation, and future improvements in savings estimation—are provided below.

Portfolio Savings

Overall, the portfolio savings claim is well-documented and carefully verified. PSE is applying RTF and PSE unit energy savings values correctly and accurately, and the various inspection practices are sound, and appear to be ensuring project quality. Review team onsite inspections did not reveal any significant issues that warrant corrections to savings.

The review team did, however, uncover several UES values for which baseline conditions varied widely from industry practice or assumptions were out-of-date, leading us to recommend corrections to the portfolio claim. The overall impact of the agreed upon corrections reduce savings by 4,244 MWh (0.61% of the biennium claim) to a total of 696,636 MWh. This is above the biennium target of 666,000 MWh. Table E-1 summarizes BECAR savings findings by program.

Cost-effectiveness Calculation

PSE has met all of the Order requirements and is generally in compliance with Council methodology, with only minor deviations regarding avoided costs, load shapes, and non-energy benefits and O&M costs.

Future Improvements in BECAR Process

A. ***Clarify scope and objectives for subsequent BECAR studies.*** The approach and emphasis of this BECAR differed substantially from the previous 2010-11 effort, and it is fair to expect that the scope and objectives for future BECARs will also evolve. That said, it is particularly important that the "rules of engagement" —most notably, the nature by which savings numbers are adjusted, and whether those adjustments apply retroactively or to future years—be established by all stakeholders clearly at

the outset. With PSE and WUTC impetus, this BECAR underwent a shift in approach, well after the work plan had been approved and the effort begun, from a focus on validating actual portfolio savings to an investigation of what information was available to PSE at what time (going back to 2010 when the business cases for some measure savings were written) in order to determine if corrections to the savings claim were warranted based on PSE internal guidelines and guidelines developed specifically for this BECAR by PSE and the WUTC. This unexpected change complicated the 2012-13 BECAR process. At the conclusion of the review, all parties needed to negotiate what kinds of UES adjustments were appropriate to make retroactively. Adding clarity early on about these types of issues would certainly improve the BECAR process.

Future Improvements in Savings Estimation

Below are suggestions, based on BECAR findings, for PSE to consider when making future program and portfolio improvements.

PSE Deemed Savings

A. *Account for non-residential lighting mark-down installations.* Develop defensible estimates of savings for CFL and LED lighting mark-downs installed in non-residential applications. Given that it appears a significant fraction (up to 20%) fall in the latter category, this may serve to increase program savings significantly.

B. ***Revise UES values highlighted in BECAR.*** The review team found several instances where PSE should examine and make appropriate adjustments to their bases for savings for the 2015 program year and beyond. These instances are summarized in Table 8 and described in further detail in the program-specific findings in Section 3.3 of the main report.

Impact evaluations

A. ***Reach agreement on study methodologies***. The review team found several instances where the PSE evaluation report responses (ERR) rejected the evaluation consultant's findings. To prevent program rejection of evaluation findings on methodological grounds, in the program planning phase of an evaluation there should be agreement on PSE impact evaluation methodology and techniques to be applied. Further, any methodology that is applied should be consistent with accepted evaluation practices. The final evaluation report should include a description and justification for the chosen methodology, including a discussion of the implications of using one methodology over another

B. ***Require consistent, high-quality evaluation reports.*** The review team observed the quality of evaluation reporting to be inconsistent, even when performed by the same evaluator. This included poor documentation of secondary information sources as well as evaluation activities. PSE can continue improving evaluation practices by requiring consistent, high quality documentation of evaluation activities to ensure confidence in evaluation results.

Cost-Effectiveness Calculations

A. ***Improve measure life consistency.*** Measure Metrics has a few inconsistencies in the value of measure life across similar measures in it and the program teams' tracking systems. Ensure measure lives in Measure Metrics and program tracking databases are consistent and up to date, since this value is critical in total resource cost (TRC) calculations. Consider using Measure Metrics like a resource manual for all measure parameters, including savings, measure life, measure cost, and load shape. Measure tracking systems should then refer to the central warehouse. Program measure variables can then be clearly tracked, updated, and source documented at least on an annual basis.

B. ***Improve load shape assignment.*** While the overall effect is small, the load shapes for certain measures: Refrigeration and Cooking; Commissioning, Controls, Energy Management Systems (CI), and Single-family vs. Multi-family, as well as, SF Space Heat vs. SF Heat Pump for heat pump measures appear to have been mis-assigned. Develop a protocol, such as a Measure Metrics look up table, so that load shapes are assigned correctly.

C. ***Improve incremental measure life assignment.*** The process by which program teams assign incremental measure costs--a critical piece in the TRC calculation--is not clear. Document the process by which incremental measure costs are applied in program tracking databases and cost-effectiveness calculations.

Table E-1: BECAR Portfolio Savings Summary

Tariff	Program / Element	% of claimed 2012-13 savings verified	2012 -2013 Claimed Savings (MWh)	2012-2013 BECAR Verified Savings (MWh)	Findings*
E201	Low Income Weatherization	100%	3,193	3,193	No issues uncovered.
E214a	SF existing - Residential Lighting	97.9%	190,238	186,181	Correction made to 2013 PSE deemed UES values for LED fixtures. Results of retailer survey show a significant portion of the program mark-down lamps (CFL and LED) are installed in non-residential facilities. This result could significantly increase program savings in 2014 and beyond. PSE deemed UES for residential and non-res CFLs and LEDs should be adjusted on a go-forward basis.
E214b	SF existing - Space Heat	98.8%	15,430	15,243	Correction made to 2013 PSE deemed UES values for heat pump measures.
E214c	SF existing - Water Heat	100%	1,454	1,454	No issues uncovered.

Tariff	Program / Element	% of claimed 2012-13 savings verified	2012 -2013 Claimed Savings (MWh)	2012-2013 BECAR Verified Savings (MWh)	Findings*
E214d	SF existing - HomePrint	100%	3,738	3,738	No issues uncovered.
E214e	SF existing - Appliances	100%	17,749	17,749	PSE deemed UES for refrigerator replacement should be adjusted on a go-forward basis.
E214f	SF existing - Showerheads	100%	10,356	10,356	No issues uncovered.
E214g	SF existing - Weatherization	100%	18,327	18,327	No issues uncovered.
E214h	Mobile home duct sealing	100%	-	-	No issues uncovered.
E214i	SF existing - Home Energy Reports	100%	12,267	12,267	No issues uncovered.
E215	SF New Construction	100%	3,953	3,953	No issues uncovered.
E216	SF Fuel Conversion	100%	3,154	3,154	PSE deemed UES for space heat conversion measures should be adjusted on a go-forward basis.
E217	MF Existing	100%	44,209	44,209	No issues uncovered.
E218	MF New Construction	100%	2,198	2,198	No issues uncovered.
E250	C/I Retrofit	100%	145,432	145,432	No issues uncovered.
E251	C/I New Construction	100%	8,328	8,328	No issues uncovered.
E253	RCM Services	100%	32,907	32,907	No issues uncovered.
E255	Small Business Lighting Rebate	100%	29,523	29,523	PSE deemed UES for lighting measures should be adjusted on a go-forward basis.
E258	Large power user, self-directed	100%	36,313	36,313	No issues uncovered.
E262	Commercial Rebate	100%	81,982	81,982	PSE deemed UES for lighting measures should be adjusted on a go-forward basis.
E254	Northwest Energy Efficiency Alliance (NEEA)		38,800	n/a	Not included in BECAR scope.
E292	Generation, Transmission and Distribution	100%	1,327	1,327	No issues uncovered.
Total		99.4%	700,879	696,636	

* The term “significant issue” means an issue or finding that warrants further investigation, and the further investigation could lead to a recommendation to update a UES value or it could lead to a program realization rate less than 1.0

1. INTRODUCTION

1.1. Background

On September 28, 2010, the Washington Utilities and Transportation Commission (Commission) issued an order to adopt a settlement agreement between Puget Sound Energy (PSE) and various stakeholder parties, including 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 (Initiative 937). The settlement agreement established the terms under which PSE agreed to operate its electric energy efficiency programs. Among the conditions in the settlement agreement was the requirement to conduct an independent third-party review of the electric energy savings reported by PSE for each biennium, beginning with 2010-2011.

The 2010-2011 Biennial Electric Conservation Achievement Review (BECAR) was performed by SBW Consulting, Inc. (SBW) under contract to PSE. The final report, which documented the methodology, findings and conclusions from the first biennial review, was issued in May 2012. It was presented to PSE's Conservation Resource Advisory Group (CRAG) in April 2012. In general, the first biennial review verified that PSE's 2010-11 savings claim for the portfolio was sound, defensible, and well-documented. The only exception was the Resource Conservation Manager Program (Tariff E253), where due to concerns that the claimed savings might be overstated, program savings were reduced slightly to account for the uncertainties existing at that time.

One of the important comments that came from the CRAG review of the 2010-2011 final report was the need for more clarity about the scope of future reviews, particularly about the level of rigor that should be placed on determining the veracity of the claimed savings. Stakeholders suggested that PSE solicit outside advice to help them more clearly develop the scope for the 2012-2013 BECAR. PSE retained the services of Schiller Consulting and CAD Consulting to conduct an advisory study[2] to advise the stakeholders about scoping of the 2012-2013 BECAR. The study, which was completed in November 2012, is referred to in this document as the Schiller report. It drew on the experience gained from the previous 2010-11 BECAR, industry experience with portfolio evaluations, and the needs and perspectives of the WUTC and CRAG. The report provided specific recommendations for improving the BECAR to better meet the needs of all stakeholders.

PSE retained a consultant team (the BECAR team), consisting of SBW Consulting, Inc., in conjunction with DNV GL and Research Into Action, to carry out the 2012-2013 BECAR with a scope largely based on the recommendations from the Schiller report. The BECAR completed the review under the direction of PSE and WUTC staff, with further input and oversight provided by the CRAG.

[2] Schiller Consulting, Inc., *Advice on the Appropriate Scope of an Independent Third-party Evaluation of the 2012-2013 Electric Conservation Program Portfolio*, for Puget Sound Energy, November 2012

This final report documents the BECAR team methodology, findings, conclusions, and recommendations, based on an examination of the 2012 and 2013 program year claims. During the course of this review, we submitted the following documents:

- **2012 Interim Report:** submitted Dec 11, 2013, covers review of most of the PSE 2012 portfolio electric savings.
- **2013 Interim Memo:** submitted March 19, 2013, covers review of the first half to three quarters of the PSE 2013 portfolio electric savings.
- **2012-13 Draft Report**: A draft version of this report was issued on April 10, 2014 for stakeholder review. This final report incorporates revisions based on feedback obtained from and decisions made in conjunction with the stakeholders.

1.2. Objectives

The primary purpose of the BECAR is to assess the extent to which the electric energy savings that PSE reported for their electric conservation portfolio in the 2012-2013 biennium were achieved. This review is limited to those existing electric conservation programs that PSE operated in 2012 and 2013, and that were the basis for the electric energy savings PSE has reported for that two-year period.

The three corresponding objectives of this review are as follows:

- **Portfolio Savings Review**. Determine the veracity of total portfolio electric energy savings[3] 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.
- **Cost-effectiveness Calculation Review**. Audit cost-effectiveness results, including reviewing the methodology, inputs, and calculations, to determine if it is consistent with the Settlement.
- **Future Improvements in Savings Estimation.** Suggest improvements to the programs savings estimates for the next biennium based on findings from recently completed evaluations, original research carried out as part of the BECAR study, or secondary information sources. PSE will consider these findings when making future program improvements.

Note that the third objective was not stated in earlier BECAR planning documents, and has been added per August 2013 guidance from PSE and the WUTC.

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

[3] The energy savings discussed throughout this report are *gross* savings, and do not take into account adjustments commonly made to derive *net* savings, including factors such as free drivers, free riders, and participant spillover.

1.3. 2012-2013 Electric Portfolio

PSE offers its customers a broad range of programs and measures, across all of its customer classes, with claimed electric energy savings of 700,879 MWh of electric energy savings during the 2012-2013 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. PSE must derive electric energy savings from either the deemed savings estimates developed by the RTF, or from other methods based on impact evaluation data or other relevant data that has verified savings levels.

The PSE *2012 Customer Solutions Annual Conservation Report* (2012 Report) claims annual electric savings of 339,486 MWh/year, at a cost for the electric portion of $91,775,000. The PSE 2013 *Annual Report of Energy Conservation Accomplishments* (2013 Report) claims annual electric savings of 361,393 MWh/year, at a cost for the electric portion of $98,616,000. Table 2 provides additional details of 2012 and 2013 claimed savings, by programs within PSE's Residential Energy Management and Business Energy Management groups.

Table 2: 2012 Portfolio Claimed Electric Savings

		Claimed Savings (MWh/year)		
Tariff	Program	2012	2013	Total 2012-13
Residential				
E201	Low Income Weatherization	1,602	1,591	3,193
E214	*Single Family existing*	119,298	137,994	257,292
	(a) Residential Lighting	86,687	103,551	190,238
	(b) Space Heat	7,345	8,085	15,430
	(c) Water Heat	580	874	1,454
	(d) HomePrint	1,942	1,796	3,738
	(e) Appliances	8,627	9,122	17,749
	(f) Showerheads	5,691	4,665	10,356
	(g) Weatherization	8,425	9,902	18,327
	(h) Mobile home duct sealing*	-	-	
	(i) Home Energy Reports	5,498	6,769	12,267
E215	Single Family New Construction	1,496	2,457	3,953
E216	Single Family Fuel Conversion	1,532	1,623	3,154
E217	Multi Family Existing	22,952	21,256	44,209
E218	Multi Family New Construction	961	1,237	2,198

		Claimed Savings (MWh/year)		
Tariff	Program	2012	2013	Total 2012-13
All Residential		153,339	172,928	326,267
Business				
E250	Commercial/Industrial Retrofit	70,516	74,916	145,432
E251	Commercial/Industrial New Construction	5,268	3,059	8,328
E253	Resource Conservation Manager Services	16,026	16,881	32,907
E255	Small Business Lighting Rebate	17,000	12,524	29,523
E258	Large Power User - Self Directed	22,482	13,831	36,313
E262	Commercial Rebate	35,456	46,526	81,982
All Business		166,747	167,737	334,485
E254	Northwest Energy Efficiency Alliance (NEEA)	19,400	19,400	38,800
Various	Generation, Transmission, and Distribution	-	1,328	1,328
Portfolio		339,486	361,393	700,879

* Savings for this element are included in (g) Weatherization, but are treated separately in this review.

1.4. Data Sources

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

- **2012 Annual Report**: Titled *2012 Customer Solutions Annual Conservation Report*, this PSE report, filed in Docket Nos. UE-970686 and UE-111881 on February 13, 2013, is the primary documentation of the claimed savings from 2012 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 seven exhibits and supplements containing supporting data and documentation.
- **2013 Annual Report:** Titled *2013 Annual Report of Energy Conservation Accomplishments*, this PSE report, filed in Docket No. UE-11181 on February 13, 2014, is the primary documentation of the claimed savings from 2013 conservation activities.
- **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 extracts from the CSY database that underpinned the results shown in the 2012 and 2013 Annual Report tables. These contained summations, and in some cases, inventories of project results for each program.
- **Sampled project files**: For the 2012 and 2013 projects sampled for review, PSE provided information available in the project file relating to equipment specifications, costs, and savings. When applicable, they also provided documentation related to verification of measure installation and operation, such as, for example, inspection reports prepared by PSE's internal Verification Team (V-team). 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.
- **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 reports and related documentation**: In addition to the final evaluation reports provided in the 2012 and 2013 Annual Reports, PSE supplied requests for proposals, work plans, and draft reports for impact evaluations underway during the review period.
- **Cost-effectiveness calculators**: In addition to the tracking database extracts described above, PSE provided other calculations supporting cost-effectiveness estimates, measure lives, and avoided costs.
- **PSE Exhibit 8, Supplement 4: Guidelines for Measure Revisions, Version 5.75, September, 2013:** Exhibit 8 provides guidelines for revising measure savings in Business and Residential tracking systems. The guidelines assist PSE program managers with two categories of measure savings revisions: Corrections and Adjustments.

2. METHODOLOGY

The BECAR process commenced with extensive planning efforts, first with development of a prioritization plan, and once that was approved, a workplan that operationalized the former. Both plans were consistent with the recommendations from the industry expert report. We performed the BECAR review of the 2012 program year as a series of six tasks laid out in the workplan, namely:

1. Regional Technical Forum (RTF) deemed savings review
2. PSE deemed savings review
3. surveys and on-site inspections
4. reviews of impact evaluation results
5. direct assessment of residential lighting savings
6. cost-effectiveness assessment

Each of these tasks is described in more detail in the subsections below. The flowchart in Figure 1 depicts the planning and task sequences graphically. By synthesizing information from these varied efforts, the review team developed overall findings and recommendations, which are documented in this final report.

In order to clearly state our findings throughout this report, the following definitions of key terms are necessary. These definitions are taken verbatim from the PSE Guidelines for Measure Revisions.[4]

> **Corrections**: These are considered either mathematical reporting errors, selection of the incorrect measure type, or measure savings claims made without complete validation in Measure Metrics. When a savings **correction** is required, PSE will adjust the savings claim at the time of error discovery and retroactively to the month in which the error first occurred—up to January of the year in which the discovery was made.
>
> **Adjustments**: These apply to measure savings with prior validation in Measure Metrics and are considered routine, occurring most often annually. **Adjustments** to savings values will be implemented the January of the following calendar year, using the UES values that were current and in place at the time of program planning (typically October or November of a calendar year) prior to the filing of an Annual or Biennial Conservation Plan (typically November or December).

[4] Exhibit 8, Supplement 4: Guidelines for Measure Revisions, Version 5.75, September 2013

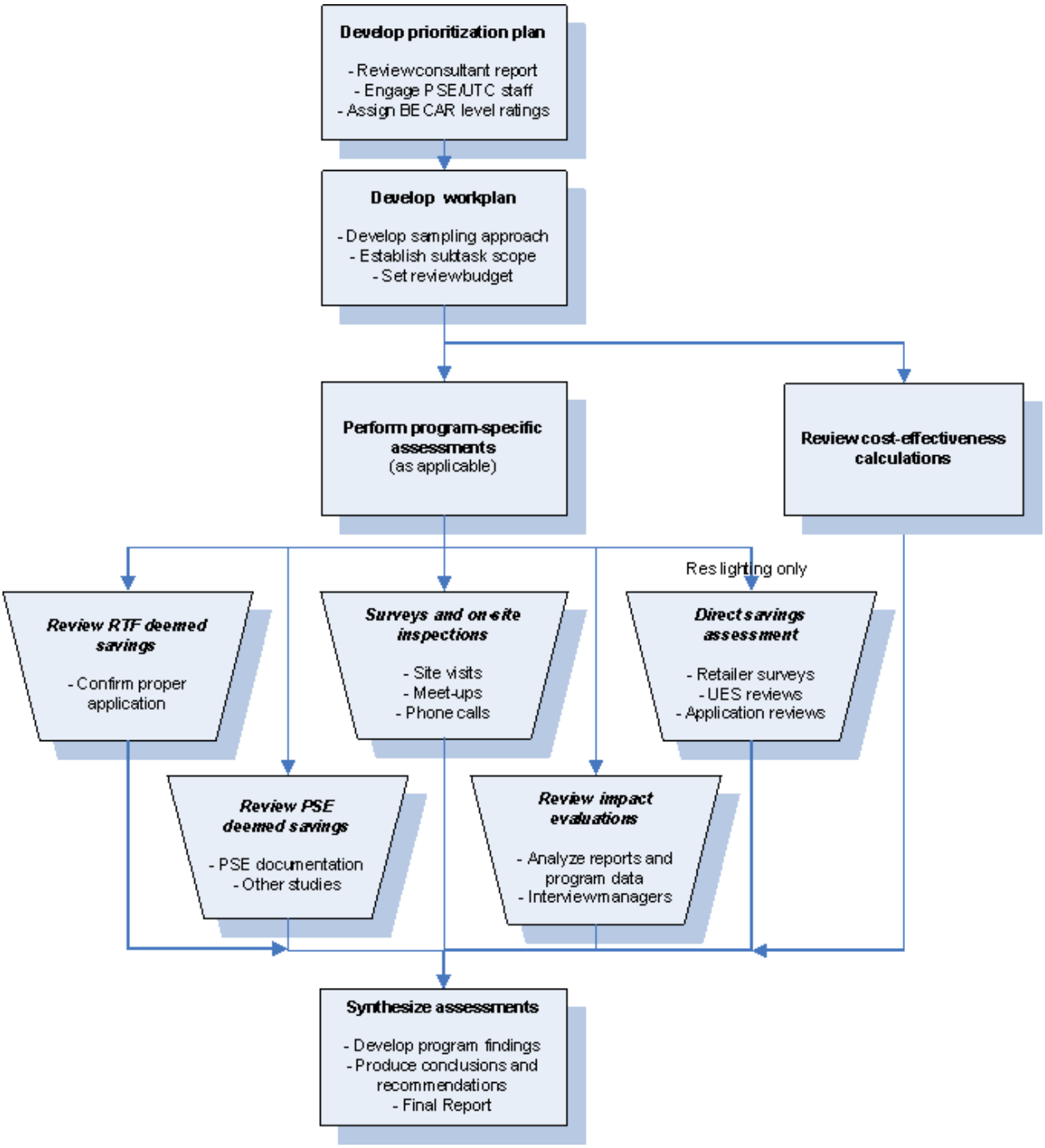

Figure 1: BECAR Overview

2.1. Planning

BECAR planning took place in two steps, in which the review team, PSE, WUTC, and CRAG first developed a prioritization plan, and then used that to create a workplan.

The purpose of the BECAR prioritization plan was to prioritize the programs to be evaluated and recommend approaches to be undertaken to independently review the 2012-2013 savings

claim and cost-effectiveness calculations for reasonableness. This plan was the initial scoping activity recommended in the Schiller report (where it is referred to as a memo). It described our approach for accomplishing the BECAR, taking into account scoping conversations between the BECAR team and key stakeholders--namely, Puget Sound Energy (PSE), the Washington Utilities and Transportation Commission (WUTC), and the PSE Conservation Resource Advisory Group (CRAG)--that occurred in late 2012 and early 2013.

We prepared the prioritization plan in advance of the evaluation workplan. We submitted a draft prioritization plan to PSE and WUTC in March 2013. We responded to review comments, and finalized it after it was submitted to the CRAG in April 2013. A summary of important methods and results included in the plan is provided below. The full prioritization plan is provided in the Appendices-Volume1.

Preparation of the workplan occurred in parallel with the prioritization plan. The workplan describes the methodologies that we were to use for each task in the study, including a preliminary sampling plan, as well as a project timeline, an initial project budget and a description of the project management structure.

The workplan is provided in the Appendices-Volume1.

2.2. Program-Specific Assessments

This task involved the implementation of the workplan for the 2012 and 2013 program years. The approaches were allowed to change as additional information became available during the review, as programs evolved or as other factors emerged.

The validation approaches included program-specific combinations of five data collection and analysis methods, as well as an overall assessment of cost-effectiveness calculations. The five methods are described below. Their applicability to the 2012 and 2013 programs is summarized in Table 3.

Table 3: Overview of Program-Specific Assessments

	Tariff		Program elements / sub-elements	BECAR review level	RTF deemed savings review	PSE deemed savings review	Surveys and on-site inspections	Review impact evaluation results	Direct assessment
Residential	E201		Low Income Weatherization	Low	●	●	●		
	E214	a	SF existing - Residential Lighting	High		●			●
		b	SF existing - Space Heat	Medium	●	●	●		
		c	SF existing - Water Heat	Low	●		●		
		d	SF existing - HomePrint	Low	●		●		
		e	SF existing - Appliances	Low	●	●	●	●	
		f	SF existing - Showerheads	Low	●			●	
		g	SF existing - Weatherization	Medium	●		●		
		h	Mobile home duct sealing	Low	●		●		
		i	SF existing - Home Energy	Low				●	
	E215		SF New Construction	Low	●	●	●		
	E216		SF Fuel Conversion	Low		●	●		
	E217		MF Existing	Medium	●		●	●	
	E218		MF New Construction	Low	●		●		
Business	E250		C/I Retrofit	Low-Medium			●	●	
	E251		C/I New Construction	Low			●	●	
	E253		RCM Services	Medium				●	
	E255		Small Business Lighting Rebate	Medium		●	●	●	
	E258		Large pwr user, self-directed	Medium			●	●	
	E262		Commercial Rebate	Low-High	●	●	●	●	
	E292		General, xmission, distribution	Low			●		

2.2.1. RTF deemed savings review

For prescriptive measures with unit energy savings based on RTF values, we accepted the approved RTF values without further review. Our analysis was limited to verifying that PSE applied appropriate values to develop their savings claim. For RTF deemed measures included the 2012 and 2013 program tracking database, we matched the measure to the corresponding record in the Measure Metrics database. We verified a key, provided by PSE, which linked the program tracking measure names to the Measure Metrics unique node ID number.

2.2.2. PSE deemed savings review

PSE deemed savings review

For prescriptive measures with unit energy savings (UES) values developed by PSE (known as "PSE deemed savings"), our review included two different tasks:

- Checking to see if PSE applied appropriate UES values to develop their savings claim. Any errors in the application of a UES will require a correction to the savings claim.
- Examining the PSE business cases/Source of Savings (SOS) referenced in Measure Metrics to determine if adjustments are warranted for 2015 and onward.

When appropriate, we also compared the PSE supporting documentation to documentation from prior studies and efficiency programs development throughout the country; with special emphasis on studies that were relevant to conditions in the PSE service area.

These review tasks were conducted for measures whose savings make a significant contribution to the 2012 and 2013 savings claim.

During our examination of the SOS, we compared the PSE supporting documentation to relevant documentation from prior studies and efficiency programs development throughout the country; with special emphasis on studies relevant to conditions in the PSE service area. This documentation included, but is not limited to:

- Previous PSE impact evaluations that included a rigorous UES review
- Northwest Power and Conservation Council Regional Technical Forum (RTF) measure workbooks
- Energy Star calculators and supporting documents
- California Energy Commission Database for Energy Efficient Resources (DEER)
- Technical Reference Manuals for the states of New York, Massachusetts, Vermont, Ohio, Minnesota, Wisconsin, Maine, New Jersey, Connecticut and Pennsylvania.
- Department of Energy Technical Support Documents

We followed the Regional Technical Forum (RTF) philosophy on free-ridership, which is to not attempt to calculate this value. For measures which have a "current practice" baseline, RTF philosophy is that the baseline would normally include some percentage of efficient case implementations. In this way the higher baseline value already accounts for free-ridership in the gross savings calculations. For measures with a "pre-conditions" baseline, the net-to-gross issue becomes a measure life issue – the remaining useful life of the old equipment reflects the length of time before it would have been replaced without program influence.

SBW had primary responsibility for the savings reviews. However, to avoid a conflict of interest, DNV GL conducted the reviews for measures that SBW has been implementing for PSE under the Commercial Rebate program.

The detailed results the reviews are documented in a MS Excel workbook that contains a spreadsheet for each reviewed measure. The spreadsheet includes a description of the basis for

the current PSE deemed value and the review team's analysis and recommended adjustments. PSE and the WUTC reviewed our initial recommended adjustments that were provided in a November, 2013, memorandum and the accompanying MS Excel workbook.

Over the course of this BECAR effort, the review team probed PSE and the WUTC for guidance on how to implement and/or proceed forward with the results of our PSE Deemed review. The directive provided by PSE and the WUTC in August, 2013 was as follows (note: the use of the term "adjustment" in the directive below is different than as defined in the Methodology section of this report. The use of the term adjustment here refers to a recommended change in the calculation method PSE used to determine savings, which could impact savings on a retro-active and/or go-forward basis):

> *If SBW finds that PSE is using a UES or savings calculation approach that varies widely from industry practice, SBW will bring that finding to the CRAG for discussion of whether an adjustment to the 2012/13 savings claim is appropriate. Unless the CRAG determines that an adjustment is appropriate, the results will be used to inform and improve the programs moving forward. These results will be documented in the final report.*

More recently, and on more than one occasion, PSE pointed the review team toward the PSE Guidelines for Measure Revisions[5]. The PSE Guidelines make no mention of an "approach that varies widely from industry practice" as a reason for a correction to a PSE Deemed UES. The PSE Guidelines state that if a PSE Deemed measure is compliant at the beginning of the year, corrections are only appropriate if an error is discovered. The PSE Guidelines include "measure savings claims made without complete validation in Measure Metrics" as a valid reason for a correction. However, "complete validation" is not well-defined within the PSE Guidelines; the example provided is "a savings claim that isn't archived in the Measure Metrics system or doesn't have supporting saving data noted." All the PSE deemed measures reviewed as part of this BECAR effort are archived in Measure Metrics and have supporting savings data noted.

According to WUTC staff, the PSE Guidelines for Measure revision are internal to PSE, and it is the understanding of the WUTC staff that the BECAR review team has the flexibility to recommend adjustments beyond what are provided for in the PSE guidelines. Concise written direction and agreement on the role of the PSE internal guidelines is an example of "rules of engagement" that we recommend be established by all stakeholders clearly at the outset of the next BECAR.

In regards to adjustments, Exhibit 8 states that in the case of the RTF making a routine adjustment to an RTF deemed savings value (not the result of an RTF error) after the beginning of the year, the measure savings in the tracking database should adjusted at the beginning of the following year. However, Exhibit 8 does not make it clear whether or not the above scenario applies to either of the following two cases:

- The RTF approving a new measure within the biennium that meets the needs of PSE program measure currently assigned a PSE deemed savings.

[5] Exhibit 8, Supplement 4: Guidelines for Measure Revisions, Version 5.75, September, 2013

- The RTF updating an existing measure upon which a PSE deemed savings value is based.

However, Exhibit 8 states: "*In order to ensure the highest possible level of saving reporting accuracy, PSE does not support the concept of retaining savings values throughout an entire biennium. One key reason is that the RTF quite often revises several high-volume UES values annually; CFL lamps and residential clothes washers, for instance."* Therefore, the review team believes it is the intent of PSE to adjust PSE deemed savings values if the RTF makes a routine adjustment to a measure upon which the PSE deemed value is based – or if the RTF approves a new measure that fits an existing PSE deemed measure. Because these are adjustments, the savings should be updated at the beginning of the following year (i.e. January, 2013, for this BECAR period,).

2.2.3. On-site inspections

On-site inspections

Per the sampling scheme developed in the workplan, we conducted site inspections on a sample of 2012 and 2013 participants in each program. The site inspections were used to assess whether PSE reported projects and measures accurately, whether they were program-eligible and operational, and whether any issues found pointed towards more systemic concerns that could lead to additional investigation.

The data collection options include:

- ***Site visits to confirm measure implementation***: these are independent site visits to inspect measures that were implemented by PSE or a third-party contractor. The sites were not previously inspected. These are listed below in Table 4 as "Regular Sites."
- ***Site visits to confirm past inspection:*** these are independent site visits similar to a "Regular" site visit except that the measure has already been inspected by the PSE verification team (V-Team), PSE energy management engineers, or third- party program implementers. These are listed below in Table 4 as "V-team Sites."
- ***Meet-up inspections:*** these are site visits that are conducted jointly with the PSE verification team (V-Team), PSE energy management engineers, or third- party program implementers to observe them performing post-implementation inspections. These are listed below in Table 4 as "Meet-Ups."
- ***Phone calls:*** when it was not possible to observe the measures, e.g., a decommissioned refrigerator, we called the site to confirm the measure application.

Table 4: 2012 and 2013 On-site inspections

		2012 Programs		2013 Programs			
Tariff	Program	Regular Sites (i.e. not V-team)	V-team Sites	Regular Sites (i.e. not V-team)	V-team Sites	Meet-Ups	Total
E201	Low Income Weatherization	1	0	1	0	0	2

		2012 Programs		2013 Programs			
Tariff	Program	Regular Sites (i.e. not V-team)	V-team Sites	Regular Sites (i.e. not V-team)	V-team Sites	Meet-Ups	Total
E214	SF-existing Space Heat	5	9	3	3	2	22
	SF-existing Water Heat	1	6	2	1	1	11
	SF-existing HomePrint	1	6	0	2	0	9
	SF-existing Appliances	12	0	4	0	0	16
	SF-exisiting Weatherization	4	9	2	4	4	23
	Moblie Home Duct Sealing	1	0	0	0	1	2
E215	SF New Construction	0	6	0	0	1	7
E216	SF Fuel Conversion	0	6	0	2	1	9
E217	MF Existing	7	7	3	1	4	22
E218	MF New Construction	0	6	0	0	0	6
	Residential Total	**32**	**55**	**15**	**13**	**14**	**129**
E250	**C/I Retrofit**						
	Standard	1	0	1	0	0	2
	Controls-based	3	0	0	0	1	4
	ESG-Rebate	0	0	1	0	0	1
	CBTU	2	0	0	0	0	2
	Energy Smart	1	0	1	0	0	2
	Data Center Efficiency	0	0	2	0	0	2
	Industrial Systems Optimization	0	0	2	0	1	3
	SBTU	0	0	2	0	0	2
E251	C/I New Construction	0	0	1	0	0	1
E255	Small Business Lighting Rebate	0	9	0	4	2	15
E258	Large Power User	4	0	0	0	0	4
E262	**Commercial Rebate**						
	Cooking Equipment	5	0	0	2	1	8
	Laundry	1	0	0	3	1	5
	Variable Speed Drives	5	0	2	0	0	7
	ECM Motors	1	0	1	0	0	2
	Heat Pump & Air Conditioner	1	0	1	0	0	2
	Hospitality	3	0	1	0	0	4
	PC Power Management	1	0	1	0	0	2
	LED Traffic Lights	1	0	1	0	0	2
	Interior Lighting	7	0	0	3	1	11
	Premium HVAC Service	5	0	2	0	1	8
	MCFL	0	0	0	5	1	6
	Green Motor Rewinds	1	0	0	0	0	1

		2012 Programs		2013 Programs			
Tariff	Program	Regular Sites (i.e. not V-team)	V-team Sites	Regular Sites (i.e. not V-team)	V-team Sites	Meet-Ups	Total
	Pre-rinse Spray Valves Direct Installs	5	0	2	0	0	7
	Cooler Miser Direct Installs	4	0	0	0	0	4
	Small Business Direct Installs	7	0	2	0	0	9
E292	General, transmission, distribution	0	0	1	0	0	1
	Business Total	**58**	**9**	**24**	**17**	**9**	**117**
	Residential+Business Total	**90**	**64**	**39**	**30**	**23**	**246**

2.2.4. Review impact evaluation results

Whenever possible, we based all or part of our review on an assessment of the results from recent PSE impact evaluations. In our assessment of evaluation results, we considered sample sizes, technical approaches and application of best practices, applicability of realization rates, and implementation of evaluation recommendations. We included interviews with relevant PSE program and evaluation staff to ensure that we had a full understanding of evaluation results and any changes that occurred to the programs after the evaluations were completed. The scope of this effort varied with the circumstances encountered for each evaluation. Considerations included:

- Was the evaluation based on a reasonable sample that adequately represented the population of the entire program? Was the sample large enough to provide high statistical confidence and precision?
- Did the evaluation use a sound technical approach that used best practice methods for data collection and analysis of measure savings? Did these methods produce reasonable estimates of savings for the sampled measures? Was this done for the PSE deemed measures, the calculated measures, and/or custom measures? Did the evaluation verify that the deemed measure savings values were properly applied?
- Did the evaluation produce realization rates that are directly applicable to this review? If the evaluation was performed on program years prior to 2012-2013, are all or portions of the results applicable to the population of program participants in the 2012-2013 program years?
- Were the programmatic action items described in the PSE internal evaluation report response (ERR) implemented, particularly those that could have potentially affected future savings values?

We also conducted interviews with relevant PSE program and evaluation staff to ensure that we had a full understanding of evaluation results and any changes that occurred to the programs after the evaluations were completed.

The following table lists the PSE impact evaluations that we reviewed as part of the 2012-2013 BECAR.

Table 5: Programs with Impact Evaluations

Tariff	Program
E214	Single-family Existing
e	Appliances (Refrigerators)
f	Showerheads
i	Home Energy Reports
E217	Existing MultiFamily Residential
E250	Commercial/Industrial Retrofit
E251	Commercial/Industrial New Construction
E253	Resource Conservation Manager
E255	Small Business Lighting Rebate
E262	Commercial Rebate
E258	Large Power User - Self Directed

* E214 Clothes Washers/Weatherization and Mobile Home Duct Sealing were included in this list in the 2012 Interim Report and 2013 Interim Memo; they should not have been because Impact Evaluations were not conducted for these programs.

2.2.5. Direct assessment of residential lighting savings

We performed a top-level assessment of the savings associated with the upstream residential lighting program. This is a key program for which there is no previous impact evaluation to review, nor is one planned in the near future. The upstream program has two components: retailer mark-downs and giveaways of CFL and LED lamps. The scope of this effort included the following four tasks:

- **Proportion Non-residential.** The program assumes that all lamps (CFL and LED) distributed under this program went to residential customers. This assumption is reasonable for the giveaway component, since they occur at events where customers are given very limited quantities and are often verified to be PSE customers. However, some of lamps that were distributed through retailer mark-downs went to non-residential customers, since they were not prevented from participating in this program. It was important to determine the fraction of the lamps that were purchased and installed by non-residential customers because the annual operating hours for non-residential lamps is typically much greater than for residential lamps.

  We estimated the sector split based on information obtained from a telephone survey of participating lighting retailers. The survey was performed by Research Into Action (RIA) on a sample of the 50 retailers that sold the greatest number of program lamps during 2012. The survey asked participating retailers a series of questions that led to an estimate of the percentages of program CFL and LED lamps sold in 2012 that were bought by business

customers. RIA and SBW analyzed the survey responses to support an estimate of the proportion of lamps that were distributed to non-residential applications across the entire program. We performed a separate analysis for CFL and LED lamps.

- **Unit Energy Savings for Residential CFLs and LEDs.** For residential customers, we accepted the RTF UES value for CFL mark-downs without review, except for applicability. The RTF values include the effects of lamp storage and removal. Since the RTF does not have UES values for CFL giveaways and LED lamps, we reviewed the PSE UES values for reasonableness and applicability. The CFL giveaway review was based on a critique of a recent PSE impact evaluation of the CFL giveaway program that considers lamp storage, removal and leakage. The LED review is based on a critique of an LED UES value that was recently adopted by the RTF and other relevant data sources.
- **Unit Energy Savings for Non-residential CFLs and LEDs.** The RTF does not provide CFL or LED UES values for non-residential customers. Our reviewed estimated the UES based on the assumption that the replacement lamps provided equal light output to the baseline lamps. We also critiqued the results from an ongoing PSE impact evaluation for programs E255 and E262.
- **Installed Lamp Counts.** We verified the installed counts documented in the PSE tracking database through a review of the monthly sales documentation provided by the retailers.

The results from this work will be used by PSE to inform and improve this program going forward.

2.3. Cost-effectiveness Assessment

The objective of this review was to examine the methodology, inputs, and calculations used to determine portfolio and program cost-effectiveness, in order to assess whether they were consistent with the terms of Order 01 of Docket No. UE-111881. The Order 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 Power and Conservation Council (the Council) approach. The settlement also stipulates that overall cost-effectiveness should be evaluated at the program and portfolio level for TRC, and that cost-effectiveness should also be assessed using Utility Cost (UC), Ratepayer Impact Measure (RIM), and Participant Cost (PC) tests at the portfolio level only. The relevant section of UE-111881 that was reviewed in context of this study is primarily Commission Orders # (10).[6] In addition, PSE's analysis must include quantifiable non-energy benefits, the 10 percent conservation benefit and risk adder consistent with the Council approach which has not changed since the 2010-11 review.[7] Collectively, these

[6] PSE indicated that it is not required to submit Participant Cost Test (PCT) and Ratepayer Impact Measure (RIM) test results per a recent agreement with the WUTC staff. As a result, these two tests are not discussed here. The tests are calculated for the biennial conservation plan (BCP) at the portfolio level.

[7] 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,

conditions comprise the standards that PSE must use in its reporting for its programs and portfolio's cost-effectiveness.

Building off the previous 2010-11 BECAR, we compared PSE's calculation methodology to the Council approach, performed due diligence reviews of the calculations, and determined if PSE is in compliance with the above-stated conditions. The team reviewed PSE's cost-effectiveness calculations and methodology that were reported in Exhibit 2 of its 2012 annual conservation report. To assess compliance, we reviewed the following elements:

1. Correct methodology, if necessary, to be consistent with National Action Plan for Energy Efficiency (NAPEE)[8] and industry practices for calculating TRC and UC.
2. Confirm consistency with the Council approach
3. Conduct due diligence review of calculations:
   - Did PSE correctly calculate the cost-effectiveness for each program and portfolio?
   - Were the proper load shapes used?
   - Were the proper program measure lives 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 methodology and ensure all elements are in compliance with the settlement agreement.

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.

[8] 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.

3. FINDINGS

3.1. Overview

Table 6 and Table 7 summarize BECAR findings for the 2012 and 2013 program years, respectively.

The subsequent portions of this section detail the findings by review type (Section 3.2) and by program (Section 3.3), along with the results from the cost-effectiveness review (Section 3.4).

Table 6: Summary of 2012 Findings

Tariff	Program / Element	2012 claimed savings (MWh)	2012 claimed savings (% of total savings)	Findings*
E201	Low Income Weatherization	1,602	0.5%	No issues uncovered.
E214a	SF existing - Residential Lighting	86,687	25.5%	Results of retailer survey show a significant portion of the program mark-down lamps (CFL and LED) are installed in non-residential facilities. This result could significantly increase program savings in 2014 and beyond.
E214b	SF existing - Space Heat	7,345	2.2%	No issues uncovered.
E214c	SF existing - Water Heat	580	0.2%	No issues uncovered.
E214d	SF existing - HomePrint	1,942	0.6%	No issues uncovered.
E214e	SF existing - Appliances	8,627	2.5%	PSE deemed UES for refrigerator replacement should be adjusted on a go-forward basis.
E214f	SF existing - Showerheads	5,691	1.7%	No issues uncovered.
E214g	SF existing - Weatherization	8,425	2.5%	No issues uncovered.
E214h	Mobile home duct sealing	-		No issues uncovered.
E214i	SF existing - Home Energy Reports	5,498	1.6%	No issues uncovered.
E215	SF New Construction	1,496	0.4%	No issues uncovered.
E216	SF Fuel Conversion	1,532	0.5%	No issues uncovered.
E217	MF Existing	22,952	6.8%	No issues uncovered.
E218	MF New Construction	961	0.3%	No issues uncovered.
E250	C/I Retrofit	70,516	20.8%	No issues uncovered.

Tariff	Program / Element	2012 claimed savings (MWh)	2012 claimed savings (% of total savings)	Findings*
E251	C/I New Construction	5,268	1.6%	No issues uncovered.
E253	RCM Services	16,026	4.7%	No issues uncovered.
E255	Small Business Lighting Rebate	17,000	5.0%	PSE deemed UES for LEDs should be adjusted on a go-forward basis..
E258	Large power user, self-directed	22,482	6.6%	No issues uncovered.
E262	Commercial Rebate	35,456	10.4%	PSE deemed UES for LEDs should be adjusted on a go-forward basis...
E254	Northwest Energy Efficiency Alliance (NEEA)	19,400	5.7%	Not included in BECAR scope.
E292	Generation, Transmission and Distribution	-		No 2012 programs.
Total		**339,486**	**100%**	

* The term "significant issue" means an issue or finding that warrants further investigation, and the further investigation could lead to a recommendation to update a UES value or it could lead to a program realization rate less than 1.0

Table 7: Summary of 2013 Findings

Tariff	Program / Element	2013 claimed savings (MWh)	2013 claimed savings (% of total savings)	Findings*
E201	Low Income Weatherization	1591	0.4%	No issues uncovered.
E214a	SF existing - Residential Lighting	103,551	28.7%	Results of retailer survey show a significant portion of the program mark-down lamps (CFL and LED) are installed in non-residential facilities. This result could significantly increase program savings in 2014 and beyond. PSE deemed UES for residential and non-res CFLs and LEDs should be adjusted on a go-forward basis. **Correction required** to 2013 PSE deemed UES values for LED fixtures. Corrected 2013 savings = 99,494 MWh
E214b	SF existing - Space Heat	8,085	2.2%	**Correction required** to 2013 PSE deemed UES value. Corrected 2013 savings = 7,898 MWh
E214c	SF existing - Water Heat	874	0.2%	No issues uncovered.
E214d	SF existing - HomePrint	1,796	0.5%	No issues uncovered.

Tariff	Program / Element	2013 claimed savings (MWh)	2013 claimed savings (% of total savings)	Findings*
E214e	SF existing - Appliances	9,122	2.5%	PSE deemed UES for refrigerator replacement should be adjusted on a go-forward basis.
E214f	SF existing - Showerheads	4,665	1.3%	No issues uncovered.
E214g	SF existing - Weatherization	9,902	2.7%	No issues uncovered.
E214h	Mobile home duct sealing	-		No issues uncovered.
E214i	SF existing - Home Energy Reports	6,769	1.9%	No issues uncovered.
E215	SF New Construction	2,457	0.6%	No issues uncovered.
E216	SF Fuel Conversion	1,623	0.4%	No issues uncovered.
E217	MF Existing	21,256	5.9%	No issues uncovered.
E218	MF New Construction	1,237	0.3%	No issues uncovered.
E250	C/I Retrofit	74,916	20.7%	No issues uncovered.
E251	C/I New Construction	3,059	0.8%	No issues uncovered.
E253	RCM Services	16,881	4.7%	No issues uncovered.
E255	Small Business Lighting Rebate	12,524	3.5%	PSE deemed UES for LEDs should be adjusted on a go-forward basis..
E258	Large power user, self-directed	13,831	3.8%	No issues uncovered.
E262	Commercial Rebate	46,526	12.9%	PSE deemed UES for LEDs should be adjusted on a go-forward basis..
E254	Northwest Energy Efficiency Alliance (NEEA)	19,400	5.4%	Not included in BECAR scope.
E292	Generation, Transmission and Distribution	-		No issues uncovered.
Total		**361,393**	**100%**	

* The term "significant issue" means an issue or finding that warrants further investigation, and the further investigation could lead to a recommendation to update a UES value or it could lead to a program realization rate less than 1.0.

3.2. By Review Type

3.2.1. RTF deemed measure review

PSE does a very good job selecting the correct RTF deemed value and entering it properly into the tracking database; we found no problems in this area.

3.2.2. PSE deemed measure review

PSE does a very good job selecting the correct PSE deemed value and entering it properly into the tracking database; we found no problems in this area.

The review team did, however, uncover several UES values for which baseline conditions varied widely from industry practice or assumptions were out-of-date, leading us to recommend corrections to the portfolio claim.PSE concurred with the review team's recommendation for three of these measures (one residential heat pump measure and two residential LED measures). For the remaining UES values in question – of which commercial LEDs are of particular interest – SBW and PSE presented the UES values and derivations to the CRAG for review and discussion. After the presentation to the CRAG, and subsequent follow-up discussions with PSE, SBW, and the WUTC, the CRAG decided that corrections to these savings values are not warranted. Therefore, the review team changed our recommendation from "correction" (i.e. retro-active change which would impact 2012-13 savings) to "adjustment" (i.e. go-forward change).

As shown below in Table 8, for many PSE Deemed measures we recommend adjustments – on a go-forward basis – to the UES values. The details regarding each of these recommended adjustments are located in the "PSE deemed saving review" sections listed under each program in Section 3.3. Many of our recommended adjustments for residential measures are based on the premise that PSE deemed savings values should track as closely as possible to new RTF deemed values. Our recommended adjustments for commercial measures are based on Order 01, Docket No. UE-111881, (6)(c), which states that UES measure savings estimates "must be based on generally accepted impact evaluation data and/or other reliable and relevant source data that has verified savings levels."

Table 8: Recommended Adjustments to PSE Deemed UES

	PSE Deemed UES (kWh/year)	Recommended Adjustment UES (kWh/year)
Engagement Bulb	20	Use 2014 RTF measure as starting point
Electric FAF to HP Conversion	5176	3912
Heat Pump - Tier 3 (10 HSPF, 16 SEER)	939	Pending*
Refrigerator Replacement	755	580
E2G Fuel Conv - Space & WH – BB	12000	14000

	PSE Deemed UES (kWh/year)	Recommended Adjustment UES (kWh/year)
E2G Fuel Conv - Space & WH – FA	12000	14000
E2G Fuel Conv - Space Heat Only – BB	8500	10500
E2G Fuel Conv - Space Heat Only – FA	8500	10500
LED: HW Recessed Retrofit Kit	112	not determined**
CFL: Screw in, less than 26 watts	139	not determined**
CFL: Screw in, 26 to 39 watts	149	not determined**
CFL: Screw in, greater than or equal to 40 watts	209	not determined**
CFL: Screw in, less than 26 watts (SBDI)	155	not determined**
LED: MR16	177	144
LED: PAR20	175	116
LED: PAR30	229	114
LED: PAR38 & 40	235	142
LED: Omnidirectional	291	104
LED: Decorative	155	86
Commercial Aerators	2423	760

* PSE has filed a revised UES this year for application in 2015.

**Review team did not have enough information to calculate a recommended UES value.

We also found three measures (listed below) where we believe corrections to the 2013 claimed savings are warranted.

- Indoor LED Fixture
- Outdoor LED Fixture
- Heat Pump Sizing & Lock out Controls

3.2.3. On-site inspections

On-site inspections did not uncover any significant issues with residential-sector or business-sector projects. Also, the PSE V- Team inspections are thorough and effective at ensuring project quality.

Residential sample

Of the 246 on-site inspections completed for this review, slightly more than half (129) were at residential sites. These 129 sites covered 11 different PSE programs / sub-programs. Sixty-eight of the sites had previously been inspected by the PSE V-team.

Across the 129 residential sites visited, we did not find any significant issues. We did find a few issues worth noting for the purpose of providing feedback that may be useful to PSE in their

future inspections. Details of these issues can be found in the "By Program" section. It is important to note, however, that in the review team's judgment, none of these issues warrant additional investigation to establish potential savings adjustments.

Business sample

Of the 246 on-site inspections, 117 are business-sector sites. These 117 sites cover 27 different PSE programs / sub-programs. Seventeen of the sites have previously been inspected by the V-team.

Across the 117 sites we visited, we did not find any significant issues. We did find a few issues worth noting for the purpose of providing feedback that may be useful to PSE in their future inspections. Details of these issues can be found in the "By Program" section. It is important to note, however, that in the review team's judgment, none of these issues warrant additional investigation to establish potential savings adjustments.

Meet-Ups

A "meet-up" inspection consists of an SBW inspector meeting a V-team inspector, third-party contractor, or PSE energy management engineer (EME) at one of their regularly-scheduled site inspections, and accompanying them throughout their inspection to observe how they carry out their work.

We completed 23 meet-up inspections: 15 with a PSE V-team member, two with a PSE EME, and six with a third-party contractor. The meet-ups covered a wide variety of REM programs (Space Heat, Weatherization, Water Heat, MHDS, Fuel Conversion, SFNC, and MF Retrofit) and BEM programs (Small Business Lighting, Commercial Rebate, C/I Retrofit).

The meet-up inspections were successful on all counts: from the point of being a well-coordinated by the V-team staff, to the courteous and cooperative nature of the joint inspections, to the end result that SBW did not find any issues, major or minor, to report from the meet-ups.

We observed the various inspectors as they verified measure counts, equipment model numbers, fuel source, measure operation, and project status. All of the inspectors we met with arrived at the site with their paperwork in order and a firm idea of what they were looking for. The third-party contractors, V-team inspectors, and PSE EME's were prepared, thorough, persistent, considerate of PSE customer's, and professional during their inspections.

3.2.4. Impact evaluation review

Generally, we found that PSE has made much progress on evaluation practices since the last biennial review, but there is still room for improvement. We observed the quality of evaluation, or at least evaluation reporting, to be inconsistent, even when performed by the same evaluator. For more detail, see evaluation reviews of the Commercial programs. Furthermore, our review noted a pattern of rejecting evaluation results that suggested lowering saving values. In these instances, PSE stated that they did not agree with the methodology used to derive the savings; however, we found that the evaluation methodologies in question followed the agreed upon scope of work. Refer to evaluation reviews of Residential programs

for more information. Going forward, PSE should closely collaborate with their contracted evaluation teams to ensure satisfactory evaluation methodologies which follow industry best-practices prior to signing off on scope of work then require consistent, high quality documentation of evaluation activities to ensure confidence in evaluation results.

3.2.5. Direct assessment of residential lighting

The review team completed a survey of the 50 mark-down retailers in the residential lighting program. They received 46 responses, which accounted for 74 percent of the total mark-down sales. The survey inquired about the fraction of their sales of program lamps that were purchased by non-residential customers. The result for the sample was 22 percent non-residential for CFLs and 20 percent non-residential for LEDs. We then extrapolated these results to the entire program. The program wide values that we computed were 17 percent non-residential for CFLs and 20 percent non-residential for LEDs.

We reported these findings to PSE and the WUTC; they directed the review team to not proceed with any further with the assessment because the recommended adjustments apply going forward and do not affect the 2012-2013 claim.

3.3. By Program

3.3.1. E201 Low Income Weatherization

This program provides weatherization and energy-related repairs for low-income, single- and multi-family residences, including mobile homes. The BECAR methodology and findings are summarized in Table 9 and Table 10, respectively, followed by relevant details of the findings.

Table 9: E201 Program Review Methodology

Percentage of 2012-2013 portfolio savings	0.5%
BECAR level (low / medium / high)	Low
RTF deemed savings review	Yes
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	No
Direct assessment	No

Table 10: E201 Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection for 2 sites; found no issues.

Impact evaluation	--
Direct assessment	--
Overall program	No issues uncovered to date.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the Low Income Weatherization sample.

On-site inspections

We inspected two Low Income Weatherization site; the sites (one 2012 and one 2013) included seven different measures, and we found no issues.

Overall program

The review team found that PSE's 2012-13 savings claim for Low Income Weatherization is sound, defensible, and well-documented.

3.3.2. E214 Existing Single Family Residential

This very large program accounts for 37% of the total electric portfolio. It has nine elements, each of which is discussed in the following sections.

3.3.2.1. (a) Lighting

This element of the E214 Single-family Existing program provides incentives and promotions so retailers can offer a wide range of compact fluorescent (CFL) and LED lamps and fixtures. It also includes give-away promotions. The BECAR methodology and findings are summarized in Table 11 and Table 12, respectively, followed by relevant details of the findings.

Table 11: E214a Program Review Methodology

Percentage of 2012-2013 portfolio savings (projected)	27.1%
BECAR level (low / medium / high)	High
RTF deemed savings review	No
PSE deemed savings review	Yes
Surveys and on-site inspections	No
Impact evaluation	No
Direct assessment	Yes

Table 12: E214a Program Review Results

RTF deemed savings review	--

PSE deemed savings review	Correction required to 2013 claim based on LED UES values. Residential LED & CFL engagement lighting should use 2014 RTF measure set as a starting point.
Surveys and on-site inspections	--
Impact evaluation	--
Direct assessment	Retailer survey and calculation of residential/business-sector sales split completed. PSE to use findings to inform this program going forward.
Overall program	Results of retailer survey show a significant portion of the program mark-down lamps (CFL and LED) are installed in non-residential facilities. This result could have a significant impact on program savings. Corrections required to 2013 claim based on review of UES for LEDs. Also, PSE deemed UES for residential and commercial lamps should be adjusted on a go-forward basis.

PSE deemed savings review

Engagement CFLs

Give-away (a.k.a. engagement) CFLs are part of the Lighting element of the Existing Single-family Residential program. The PSE deemed savings value (Program UES) is shown in Table 13 along with the review team's recommended go-forward UES (Review Adjustment UES).

Table 13: UES for PSE deemed give-away CFLs

Measure	Program UES (kWh/yr)	Review Adjustment UES (kWh/yr)
CFL Engagement bulbs	20	Use 2014 RTF measure as starting point

PSE derived the deemed savings value from the RTF residential CFL measure[9]. PSE applied an installation rate of 74% to the RTF savings assumptions. The installation rate is based on a phone survey with 246 respondents six months following the give-away event.

This component of the lighting program was recently evaluated by DNV GL[10]. DNV GL found an installation rate of 73%. In addition, DNV GL found an overall "leakage" rate of 35%. These were phone survey respondents who received give-away CFLs who were not PSE electric customers. While DNV GL had data for this leakage out, no data exist for leakage in.

Leakage is not considered in the PSE savings calculations for marked down CFLs; presumably leakage out is assumed to equal leakage in. The neighboring electric districts in Seattle and

[9] CFL Engagement Bulbs: 2012 Business Case – Measure Metric – Source of Savings

[10] DNV GL, CFL and Showerhead Engagement Program Final Report (Project #20270021), Prepared by DNV GL, Inc. June 18, 2013

Tacoma have had CFL give-away programs, but they may be phasing out these programs – in which case, leakage out will not equal leakage in.

The RTF is currently updating the residential CFL measure[11]. The baseline for the updated measure is the mix of residential lighting found in the recent Residential Building Stock Assessment (RBSA)[12]. Our recommendation is that PSE update the engagement CFL measure in 2014 using the new RTF measure as a starting point, continue to apply an installation rate, and consider applying a leakage rate factor – particularly if neighboring utilities eliminate their give-away programs.

LEDs

LEDs are also part of the Lighting component of the Existing Single-family Residential program. The RTF did not adopt a residential LED measure until February, 2013, so the PSE deemed values were developed from other RTF measure workbooks. The PSE deemed savings values (Program UES) are shown in Table 14 along with the review team's recommended go-forward values (Review Adjustment UES) and required corrections for the 2013 claim.

Table 14: UES for PSE deemed residential LED measures

Measure	Program UES (kWh/yr)	Review Team's Recommended 2013 Correction UES (kWh/yr)	Review Adjustment UES (kWh/yr)
LED A-lamps	33	--	Use 2014 RTF measure as starting point
LED interior fixtures	50	24	Use 2014 RTF measure as starting point
LED exterior fixtures	143	58	Use 2014 RTF measure as starting point

For LED A-lamps, PSE derived savings using assumptions from the RTF measure for residential Specialty Energy Star lighting. Key assumptions are shown in Table 15.

Table 15: Key assumptions for PSE deemed UES; LED A-lamps measure

Key assumptions	Value	Source
Baseline watts per lamp	66.75	RTF Estar Specialty lighting "A-Lamp" baseline
Measure watts per lamp	10	RTF Specialty Estar lighting workbook for LED downlights
Hours/day	1.9	RTF Estar Specialty lighting A-Lamp, Source: "Cadmus" (same as RTF CFL)

[11] http://rtf.nwcouncil.org//meetings/2013/10/ResCFLLighting_v2_3_proposed%20v12.xlsm

[12] http://rtf.nwcouncil.org//meetings/2013/10/SF%20Lighting%20for%20RTF%20Measures%202013_10_12.xlsx

Key assumptions	Value	Source
HVAC interaction yield	85%	Net savings after HVAC hit, RTF
Storage	1%	RTF Specialty Estar lighting workbook for LED downlights
Removal	0%	RTF Specialty Estar lighting workbook for LED downlights
Take back	0%	RTF Specialty Estar lighting workbook for LED downlights

The RTF specialty lighting measure cites a study by DNV GL which found average watts per A-lamp to be 66.75W[13]. However, this value is based on pre-Energy Independence and Security Act (EISA) standards. In June, 2011, the RTF adjusted the baseline lamp wattage for its CFL measure from 61.2W to 57.5W to account for EISA[14]. Using the same pre-to-post-EISA ratio as the RTF used for CFLs, the LED baseline A-lamp wattage would have been 62.7W. Leaving all other assumptions noted in the Source of Savings[15] unchanged, this update to the baseline wattage would have decreased the UES from 33 to 31 kWh/year. However, based on marketplace feedback from retail and manufacturer partners, which indicated that retailers had sufficient quantities of pre-EISA lamps in inventory, PSE determined that including EISA impacts was premature. The review team agrees with PSE's assessment.

For LED fixtures, PSE derived savings using assumptions from the RTF measure for residential CFL fixtures, and from the RTF Specialty Energy Star lighting measure[16]. Key assumptions are shown in Table 16[17,18].

Table 16: Key assumptions for PSE deemed UES, LED fixture measure

Key assumptions	Value	Source
Lamps per fixture	2	RTF CFL fixture measure
Exterior baseline watts per lamp	60.27	RTF exterior incandescent baseline, RTF CFL fixture measure (equal lumens)
Interior baseline watts per lamp	57.54	RTF interior incandescent baseline, RTF CFL fixture measure (equal lumens)
Measure watts per lamp	10	RTF Specialty Estar lighting workbook for LED downlights
Exterior hours/day	3.9	RTF CFL fixture measure

[13] http://rtf.nwcouncil.org//measures/measure.asp?id=142
[14] http://rtf.nwcouncil.org//measures/measure.asp?id=141
[15] PSE, LED Bulbs, Business Case – Measure Metric – Source of Savings
[16] PSE, LED Fixtures, Business Case – Measure Metric – Source of Savings
[17] RTF Specialty lighting - http://rtf.nwcouncil.org//measures/measure.asp?id=142
[18] RTF CFL measure - http://rtf.nwcouncil.org//measures/measure.asp?id=141

Key assumptions	Value	Source
Interior hours/day	1.7	RTF CFL fixture measure
Storage, takeback, removal	100%	RTF CFL fixture measure
HVAC interaction yield	85%	RTF value for net savings after HVAC

We examined program accomplishments (participant sales records) for September, 2012. Average wattage among the 119 marked-down indoor LED fixtures sold was 12W (i.e. single lamp). Only three exterior fixtures were sold during the month, all of them also single-lamp. Therefore, the review team believes that two lamps per fixture was not a good assumption. The review team believes that it is "industry standard" to check program accomplishments (or other sources) within the biennium to verify an assumption such as lamps per fixture. All other assumptions are reasonable.

In February, 2013, the RTF adopted a residential LED measure. The RTF baseline reflects the penetration of CFL's in the market found in the recent regional Residential Building Stock Assessment (RBSA)[19]. For 2014, we recommend PSE use the RTF measure set as the starting point for its residential LED measures.

Direct assessment

We began the direct assessment of the 2012 residential lighting program with the task of determining the portion of the 2012 program savings that were attributable to non-residential customers. We divided the 2012 claim for the residential lighting program into two groups: the mark-downs (CFLs and LEDs) and the giveaways (CFL only). We assumed that the giveaways were all residential.

The review team completed a survey of the 50 mark-down retailers in the residential lighting program with the greatest sales in 2012 (based on an analysis of one randomly selected month of 2012 sales data). They received 46 responses, which accounted for 74 percent of the total mark-down sales. The survey inquired about the fraction of their sales of program lamps that were purchased by non-residential customers. In addition to a pre-set list of questions, the survey engaged each customer in a customized conversation to better understand the basis for their estimates and gauge the confidence of their responses. The final result for each case was an estimate of the percent of total program sales that was non-residential.

We analyzed the results for reasonableness, and assigned a confidence level (high or low) to each respondent based on the interview results. We removed the low confidence cases and computed a sales-weighted average non-residential fraction for both CFLs and LEDs across the high confidence sampled cases. The result for the sample was 22 percent non-residential for CFLs and 20 percent non-residential for LEDs.

We then extrapolated these results to the entire program. We assigned the average values to the low confidence sampled cases and the large retailers that were not sampled. We assumed

[19] http://rtf.nwcouncil.org//meetings/2013/10/SF%20Lighting%20for%20RTF%20Measures%202013_10_12.xlsx

that the small retailers and the giveaways were all residential. The program wide values that we computed were 17 percent non-residential for CFLs and 20 percent non-residential for LEDs.

The next task was to review the Unit Energy Savings (UES) for Residential CFLs and LEDs. For residential customers, we accepted the RTF UES value for CFL mark-downs without review, except for applicability. The RTF values include the effects of lamp storage and removal. The RTF does not have UES values for CFL giveaways or LED lamps; therefore we reviewed the PSE deemed UES value for reasonableness and applicability (see the PSE deemed savings review in the previous section).

We then reviewed the UES for Non-residential CFLs and LEDs. The RTF does not provide CFL or LED UES values for non-residential customers. Therefore, we reviewed the PSE deemed UES by lamp type and wattage (see PSE deemed savings review sections in Section 3.3.10). We originally intended to base our review on an analysis of lamp energy characteristics data collected during the implementation and/or evaluation of other PSE non-residential programs. However, due to the over-lapping Commercial Rebate and Small Business Lighting (SBL) Impact Evaluation being conducted by Navigant Inc., we agreed with PSE to not request lighting program data from PSE in order to not overwhelm the staff and/or duplicate effort. Our critique of the results of the Commercial Rebate and SBL impact evaluation is covered in Section 3.3.10.

We also verified the installed counts documented in the PSE tracking database through a review of the monthly sales documentation provided by one of the retailers. We did not find any data entry errors discovered in the 2012 or 2013 tracking data.

Overall program

Results of retailer survey show a significant portion of the program mark-down lamps (CFL and LED) are installed in non-residential facilities. This result could significantly increase program savings in 2014 and beyond.

The PSE deemed UES values for LED indoor fixtures, and LED outdoor fixtures should be corrected in the 2013 claim. Also, we recommend the PSE deemed UES for residential and non-res CFLs and LEDs be adjusted on a go-forward basis.

3.3.2.2. (b) Space Heat

This element of the E214 Single-family Existing program provides air-source, geothermal, and ductless heat pumps, as well as integrated space and water heating. The BECAR methodology and findings are summarized in Table 17 and Table 18, respectively, followed by relevant details of the findings.

Table 17: E214b Program Review Methodology

Percentage of 2012-2013 portfolio savings (projected)	2.2%
BECAR level (low / medium / high)	Medium
RTF deemed savings review	Yes
PSE deemed savings review	Yes

Surveys and on-site inspections	Yes
Impact evaluation	No
Direct assessment	No

Table 18: E214b Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	2013 savings correction required for Heat Pump Controls measure.
Surveys and on-site inspections	Completed review and inspection for 22 sites; found no issues.
Impact evaluation	--
Direct assessment	--
Overall program	PSE deemed saving correction required for 2013 claim.

RTF deemed savings review

We found no issues regarding the application of the UES value for the RTF deemed measure type in the Space Heat sample.

PSE deemed savings review (Heat Pump Conversion, Controls, and Upgrades)

As part of the Space Heating element of the Existing Single-family Residential program, PSE incentivized:

- Conversion from electric forced-air furnace (FAF) to air-source heat pump.
- Controls and right-sizing for a new heat pump.
- Upgrades from standard efficiency air-source heat pump to high efficiency units.

The PSE deemed savings values (Program UES) are shown in Table 19 along with the review team's recommended go-forward UES (Review Adjustment UES) and required corrections for the 2013 savings claim.

Table 19: UES for PSE deemed heat pump measures

Measure	Program UES (kWh/yr)	Review Team's Recommended 2013 Correction UES (kWh/yr)	Review Adjustment UES
FAF-to-heat pump conversion	5176	--	3912
Heat pump controls	1447	1152	Pending updated RTF value (kWh/yr)
Energy Star Heat Pump - Tier 1 = 8.5 HSPF, 14 SEER	408	--	Retired

Measure	Program UES (kWh/yr)	Review Team's Recommended 2013 Correction UES (kWh/yr)	Review Adjustment UES
Energy Star Heat Pump - Tier 2 = 9.0 HSPF, 14 SEER	554	--	Pending updated RTF value (kWh/yr)
NEW Energy Star Heat Pump - Tier 3 = 10.0 HSPF, 16 SEER	939	--	Pending*

* PSE has filed a revised UES this year for application in 2015.

FAF-to-heat pump conversion: At the time the PSE deemed value for FAF-to-heat pump conversion was originally developed, the active RTF heat pump conversion measures were not applicable because (1) prior to May, 2011, the RTF measure integrated duct sealing and commissioning with the conversion savings[20], and (2) after May, 2011, the RTF measure was for conversion to a HSPF 7.7 heat pump[21].

Because the RTF conversion measures were not applicable when this measure was developed by PSE, savings for this measure were derived for PSE by Ecotope according to regionally accepted methods – using the SEEM simulation program with "last-in" assumptions.

The RTF has since updated (date unknown) the heat pump conversion measures to no longer require duct sealing or commissioning, controls, and sizing (CC&S); also, the measure heat pump efficiency is now HSPF 8.5/SEER 14[22]. The updated RTF measure should meet PSE's requirements. We recommend updating to the new RTF measure set, with a savings value as shown above in Table 19.

Heat pump controls: The assumptions now in use for the RTF CC&S measure are substantially the same as the PSE heat pump controls measure. The RTF savings have been in effect since April, 2012, and therefore the review team believes that PSE should have adjusted their deemed savings value at the beginning of 2013.

This measure is in the process of being updated by the RTF; when the updated RTF savings become active it should be assigned to this PSE measure.

Heat pump upgrades: When Ecotope developed the heat pump upgrade measures savings for PSE, the active RTF upgrade measures included duct sealing and commissioning. The RTF has since updated the heat pump upgrade measures to not require duct sealing or CC&S. Also, the baseline heat pump efficiency was updated by the RTF in August, 2010, to HSPF 8.5/SEER 14. New upgrade measures (with the exception of the highest efficiency, Tier 3, heat pump) based on these assumptions took effect in April, 2012; therefore PSE could have adjusted their

[20] Res_DHP&HPConversions_UpgradesFY09v1_3.xlsx

[21] ResExistSFConversionHiEffHP_v1 (10-1-10).xls

[22] RTF, Residential: Heating/Cooling - Air Source Heat Pump Conversions SF, http://rtf.nwcouncil.org//measures/measure.asp?id=128

deemed savings value at the beginning of 2013. However, in November, 2012, a savings review was published by KEMA in collaboration with PSE's Evaluation department. PSE's internal Evaluation Response Report documented a summary of these findings and an action plan that noted that because the evaluation validated PSE savings metrics "PSE will continue to offer the current heat pump rebates targeting electric-only homes… and will use the findings to assist in 2014-2015 planning." Based on this information, SBW agrees that a retroactive correction to the savings is not warranted.

However, the KEMA study approached the subject in a manner different than PSE and RTF practice. KEMA did a market study for the dual purposes of estimating savings potential, and of estimating free-ridership. KEMA was apparently assuming that PSE would make a net-to-gross (NTG) reduction in savings. With a NTG adjustment, it is appropriate to use as a baseline the federal standard efficiency level, which is what KEMA assumed as the baseline. For heat pump upgrades, KEMA found a NTG factor of 63%.

RTF practice is to *not* apply a NTG adjustment, but to instead *adjust the baseline*. To develop a NTG factor requires surveying users to determine what they would have done without a utility incentive. The alternative RTF practice is to gather data to find what customers are actually doing, and to develop a market average baseline. The market data shown in the study support the RTF baseline (or higher), which is higher than the minimum federal standard. For this reason SBW does not believe PSE should move forward based on the KEMA study, but should instead switch to the current RTF measure. Developing the potential in this savings category will probably require developing new measures with higher tiers of efficiency. More information on RTF market average, or "current practice" baselines can be found here: http://rtf.nwcouncil.org/subcommittees/Guidelines/RTF_Guidelines_2013-04-16.pdf

On-site inspections

We inspected 22 Space Heat sites encompassing six different measure types; we found no issues. The 22 sites included two "meet-up" sites and twelve sites which had been previously inspected by the V-team. Our findings are consistent with the V-team at all twelve sites; this includes two sites where our inspections confirmed that the issues initially discovered by the V-team have been correctly resolved.

Overall program

Applying the PSE deemed UES corrections to the 2013 claim reduces the Space Heat savings by 186,735 kWh.

3.3.2.3. (c) Water Heat

This element of the E214 Single-family Existing program provides efficient water heaters and heat pumps, as well as wastewater heat recovery systems. The BECAR methodology and findings are summarized in Table 20 and Table 21, respectively, followed by relevant details of the findings.

Table 20: E214c Program Review Methodology

Percentage of 2012-2013 portfolio savings	0.2%
BECAR level (low / medium / high)	Low
RTF deemed savings review	No
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	No
Direct assessment	No

Table 21: E214c Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection of 11 sites; we found no issues.
Impact evaluation	--
Direct assessment	--
Overall program	No issues uncovered.

RTF deemed savings review

We found no issues regarding the application of the UES value for the RTF deemed measure type in the Water Heat sample.

On-site inspections

We inspected eleven Water Heat sites, which included two different measure types; we found no issues. Seven of the sites have been previously inspected by the V-team, and at one site we conducted a “meet-up” inspection. Our findings are consistent with the V-team at all of the sites.

Overall program

The review team found that PSE’s 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.2.4. (d) HomePrint

For this element of the E214 Single-family Existing program, HomePrint specialists evaluate homes and install low flow showerheads and CFLs. The BECAR methodology and findings are summarized in Table 22 and Table 23, respectively, followed by relevant details of the findings.

Table 22: E214d Program Review Methodology

Percentage of 2012-2013 portfolio savings	0.5%
BECAR level (low / medium / high)	Low
RTF deemed savings review	Yes
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	No
Direct assessment	No

Table 23: E214d Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection for nine sites; found no significant issues.
Impact evaluation	--
Direct assessment	--
Overall program	No significant issues uncovered.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the HomePrint sample.

On-site inspections

We inspected nine HomePrint sites which included two different measure types. The third-party implementer has conducted phone surveys for eight of these sites.

Across the nine sites we visited, we did not find any significant issues. We did find two issues worth noting here for the purpose of providing feedback that may be useful to PSE in their future inspections:

> **Uninstalled CFLs.** At one HomePrint site we found only 14 CFLs installed. The V-team field form, which was completed via third-party phone survey, reports the same quantities as the tracking database: 19 installed CFLs.
>
> **Ambiguous V-team comment**. At another site we found one HomePrint site with 12 program CFLs installed, which matches the measure count in the tracking database. The V-team field form, which was completed via third-party phone survey, records a “Match” but includes a comment reporting only 10 installed CFLs.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.2.5. (e) Appliances

This element of the E214 Single-family Existing program provides efficient clothes washers, refrigerators, and freezers, as well as pickup, recycling and rebate for working refrigerators and freezers. The BECAR methodology and findings are summarized in Table 24 and Table 25, followed by relevant details of the findings.

Table 24: E214e Program Review Methodology

Percentage of 2012-2013 portfolio savings	2.5%
BECAR level (low / medium / high)	Low
RTF deemed savings review	Yes
PSE deemed savings review	Yes
Surveys and on-site inspections	Yes
Impact evaluation	Yes
Direct assessment	No

Table 25: E214e Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	Recommended go-forward adjustment for refrigerator replacement measure.
Surveys and on-site inspections	Completed review and inspection (or phone call) for 16 sites; found no issues
Impact evaluation	Refrigerator Evaluation: suggest further work to determine better HVAC interaction factor for Replacement program and establish better understanding of free ridership and secondary market impacts as applicable to all three refrigerator programs.
Direct assessment	--
Overall program	Preliminary findings are consistent with PSE's plans for modifying various refrigerator and clothes washer UES values for 2014-15 biennium.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the Appliances sample.

PSE deemed savings review

As part of the Single-family Appliances program, PSE provided replacement of an old refrigerator with a new Energy Star model. The PSE deemed savings value (Program UES) is shown in Table 26[23] along with the review team's recommended go-forward UES (Review Adjustment UES)

Table 26: UES for PSE deemed refrigerator replacement

Measure	Program UES (kWh/yr)	Review Adjustment UES (kWh/yr)
Refrigerator Replacement	755	580

The PSE deemed savings value is based on a 2005 California study[24] in which savings for low-income refrigerator replacement were derived by analysis of electric bills.

We find the 2005 California derivation of savings to be reasonable, with two caveats.

1. Energy consumption of an Energy Star replacement unit in 2005 would have been greater than that of a comparable model purchased in 2012. For this reason, the PSE savings value is likely too low.
2. The savings derived in the 2005 study were based on a billing analysis. Savings of this low of a magnitude would be difficult to extract from a billing analysis, and the values correspondingly have a large error margin.

In 2013, this measure was evaluated by DNV GL as part of the refrigerator evaluation[25]. Savings were derived from pre- and post-metering. Based on the metering, the evaluation determined refrigerator savings to be 789 kWh/year. DNV GL then applied a net-to-gross factor to the refrigerator savings value; they used 95% (for basic replacement) and 65% (for Energy Star replacement). DNV GL also applied an HVAC interactive factor of 47%; this value is based on an electric heating saturation of 74% (as in the study) and a space heating factor of 27% (the fraction of days with average temperature above 60 °F). Evaluated net savings according to the DNV GL report were 337 kWh/year.

The RTF uses an overall HVAC interactive factor of 86%. The RTF factor is based on an electric heating saturation of 46%, and a space heating factor of 50% (i.e. only 50% of savings are

[23] Source of Savings and Measure Cost/Measure Life Refrigerator Replacement, SOS-MC_RefrigeratorReplacement.docx

[24] West Hill Energy & Computing, Inc., Impact Evaluation of the 2005 California Low Income Energy Efficiency Program, Final Report submitted to SCE, August, 2008

[25] DNV GL, Residential Refrigerator Impact Evaluation with PSE Evaluation Report Response, August, 2013

actually realized). Because of the large discrepancy between the HVAC interactive factors used by DNV GL and the RTF, the review team performed residential energy use simulations, using SEEM, to determine an appropriate HVAC interactive factor

SEEM uses a default internal gains input of 2329 Btu/hour. In order to represent the decrease in refrigerator waste heat due to installing an efficient model we reduced the internal gains by the amount of refrigerator savings determined by DNV GL (789 kWh/year). The differences in heating and cooling energy reported by SEEM were used to derive an electric and overall HVAC factor.

We modeled a 2200 square foot home in Seattle, for three heating system types. Table 27 shows the SEEM increase in total space conditioning energy usage in the home with lower internal gains. To develop an overall HVAC factor, saturations of each heating system type are based on RTF 6th Plan assumptions[26]. Homes are assumed to not have cooling, except for the heat pump homes.

Table 27: SEEM results for refrigerator replacement

Heating system type	Space conditioning consumption increase with efficient refrigerator (kWh/year)	Heating system saturation
Zonal	496	44%
Force-air furnace	564	34%
Heat pump	197	22%

The resulting weighted average is a space conditioning consumption increase of 453 kWh/year. The space conditioning increase combined with the efficient refrigerator savings of 789 kWh/year results in an electric yield of 43%.

Combining this 43% electric yield with an electric saturation of 46% (we assumed RTF values for electric and non-electric heating system saturations – 46% electric rather than the 74% found among study participants) leads to an overall HVAC yield of 74%. Applying this factor to the gross savings noted above leads to our recommended go-forward savings of 580 kWh/year. This is gross savings; we are following RTF practice on gross and net savings as discussed in the introduction.

Note that we did not attempt to model a low-income home, or apply any other low-income assumptions in our calculations because we do not have data to inform any such assumptions. We used average Heating Zone 1 for regional assumptions.

On-site inspections

We called or inspected 16 Appliances sites encompassing six different measure types; we found no issues.

[26] http://rtf.nwcouncil.org//measures/support/files/RTFStandardInformationWorkbook_v1_5.xlsx

Impact evaluation

The evaluator sought to estimate gross and net savings for three refrigerator programs with different delivery mechanisms: Replacement, Rebate and Decommissioning. They relied on extensive data collection via in situ pre- and post-metering and on-site surveys as well as participant and non-participant phone surveys. Specifically, they applied pre- and post-metering results from 83 homes to establish in situ baseline and program Unit Energy Consumption (UEC) values with 10% error bands at 90% confidence. Then they compared in situ UECs to label UECs to develop adjustment factors, using the ratio estimator approach to extrapolate from sampled units to the program population. The UECs were applied as appropriate in each refrigerator program to the participant population based on tracking data to calculate gross savings. Furthermore, the evaluator used phone surveys to characterize refrigerator purchase and disposal activities, particularly how the programs affected those activities among participants. The evaluation completed 452 surveys of program participants and 404 surveys of non-participants. They applied the survey results to determine net savings for the Replacement and Rebate programs. Also, they surveyed used unit resellers to examine secondary market impacts of the Decommissioning program which were incorporated into the gross savings estimate for this program. Table 1 presents evaluation savings for each program.

Program	Measure Life (Years)*	Annual Savings (kWh)	Annual Net Savings (kWh)
Decommissioning	11	150.4	
Replacement	1-10	372.6	337.3
	11-20	55.5	36.1
Rebate - Tier 2	1-14	67.1	49.5
	15-20		15.4
Rebate - Tier 3	1-14	66.5	66.4
	15-20		15.3

* This evaluation relied on RTF measure lives.

Overall, the evaluation followed sound methodology, which meets or exceeds industry best practices, particularly in situ metering, and was generally well-documented. However, one area of concern is the HVAC interaction factor applied to the gross savings estimate for the Replacement program. Half of the reduction was due to the assumption that 74% of the year participant homes are in heating mode "based on extensive billing analysis work for PSE". In our judgment, this is too high. Furthermore, the report was not clear if the billing analysis work was part of this evaluation (not mentioned elsewhere as part of this evaluation) and generally provided insufficient information about the billing analysis such as purpose, population, and methodology. Combined with the finding that 73% of homes in the participant population are electrically heated, the resulting evaluation HVAC interaction factor of 47% is a much larger reduction than the RTF HVAC interaction factor of 86%, reducing gross savings by more than half. But it should be noted that the electric vs. gas heating distribution assumed in the RTF

factor for this region is significantly different than the population in PSE's Replacement program which, at least during the evaluation period was lower income, more manufactured housing, and/or more rural. The correct factor is probably somewhere between 47% and 86%.

Status Update on ERR Action Items

PSE implemented following actions as planned effective January 1, 2014:

- Refrigerator Replacement program
  - Modified evaluation gross savings of 578 kWh (changed HVAC interaction factor to that of RTF)
- Refrigerator Decommissioning
  - Rejecting evaluation findings, maintaining use of RTF savings value
- Refrigerator Rebate
  - Rejecting evaluation findings, maintaining use of RTF savings value

Review Conclusions

The evaluation adhered to the scope of work agreed to with PSE which followed well-accepted evaluation practices. PSE raised valid concerns about some of the findings. In particular, we agree with PSE that the HVAC interaction factor is likely too high for the Replacement program, particularly the percent of year assumed in heating mode. Further study may be required to establish a better HVAC interaction factor for the Replacement program participant population. Another concern involved application of process results to savings estimations. PSE disagreed with the net/free-ridership adjustment. Critical review of the process side of the evaluation is beyond the scope of this impact evaluation review. However, we generally conclude that PSE should question methodology at the time of development, before agreeing to it. In future rounds of evaluation, they should work with the evaluator to develop a scope/methodology which will more satisfactorily/accurately capture free-ridership and secondary market effects.

Overall program

Preliminary findings are consistent with PSE's plans for modifying various refrigerator and clothes washer UES values for 2014-15 biennium.

3.3.2.6. (f) Showerheads

This element of the E214 Single-family Existing program provides free low-flow showerheads to residential customers. The BECAR methodology and findings are summarized in Table 28 and Table 29, respectively, followed by relevant details of the findings.

Table 28: E214f Program Review Methodology

Percentage of 2012-2013 portfolio savings	1.5%
BECAR level (low / medium / high)	Low
RTF deemed savings review	Yes

PSE deemed savings review	No
Surveys and on-site inspections	No
Impact evaluation	Yes
Direct assessment	No

Table 29: E214f Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	--
Surveys and on-site inspections	--
Impact evaluation	Generally no issues.
Direct assessment	--
Overall program	No issues uncovered.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the Showerheads sample.

Impact evaluation

This review focused on the showerheads measure in the Engagement Evaluation. The evaluator sought to determine the validity of applying RTF savings for showerheads distributed through direct mail campaign to PSE engagement event participants by estimating leakage, installation rate, placement (primary or secondary shower) and water heat fuel. Twenty-four percent of recipients left insufficient information to determine whether they were PSE customers. Among recipients who left sufficient information, the evaluation confirmed 71% to be PSE customers. The evaluator surveyed a sample of recipients who left sufficient contact information 60 days after receiving a showerhead from a PSE Engagement event. The sample size of 141 survey completions achieved 10% error at 90% confidence. The surveys found 89% of recipients purchase water heat fuel from PSE. Among those, 59% purchase gas water heat and 41% purchase electric water heat. The installation rate of the showerheads varied slightly by water heat fuel - 66% for gas water heat and 62% for electric water heat. These are lower than the RTF installation rate of 76% for mail-in campaigns. Furthermore, placement of showerheads in primary or secondary showers also varied by water heat fuel. For gas water heat, the evaluation found recipients installed 86% of engagement showerheads in primary showers and 14% in secondary showers; while for electric water heat, the distribution was 78% in primary and 22% in secondary. Savings from showerheads in secondary showers are less than those in primary showers. The evaluation formed four distinct ranges of factors to adjust the RTF savings value based on combinations of PSE customer status, installation rate, water heat fuel and showerhead placement. PSE did further internal analysis to establish a firmer percentage of recipients that were likely PSE customers as well as distribution of water heat fuel. The

Status Update on ERR Action Items section below provides more information on PSE's modifications.

Overall, the evaluation followed the methodology described in the work plan and did the best that could be expected from the information obtained through the Engagement events. It could not provide a firm set of adjustment factors due to the large portion of insufficient recipient contact information.

Status Update on ERR Action Items

As mentioned above, PSE conducted further internal analysis to minimize the unknown fraction of PSE customer status. They revised the leakage rate from a range of 54-71% to 88-100% using a match to their customer databases both with exact match analysis (88%) and zip code analysis (100%). They concluded that the average of the latter two, 94%, was a reasonable adjustment. Furthermore, they adjusted the water heat fuel distribution to reflect that of their entire service territory rather than just the pool of recipients surveyed during this evaluation. Based on these adjustments, PSE implemented the following UESs effective January 1, 2014:

Showerhead Combined water-heat fuels – 103 kWh and 5 therms

Showerhead Electric-only – 125 kWh

PSE will perform these surveys annually to verify customers from these events. Any adjustments will be applied to the next program year, rather than retro-actively. To address the issue of obtaining insufficient and erratic recipient contact information, in future Engagement events, PSE plans to do a better job of encouraging recipients to leave full, accurate name and address and to collect this information electronically at the event.

Review Conclusions

While the leakage rate, or percent confirmed as PSE customers, determined by the evaluation was likely too low, the rate developed and applied by PSE seems too high, particularly the arbitrarily picked midway point of 94%. Due to all the uncertainty, a more conservative approach would be to use the upper end of the evaluation range, 71%, for program year 2014. Then the leakage rate should be further honed in after the next round of events and surveys. Otherwise, we agree that applying the water-heat fuel distribution of the entire PSE service territory is more appropriate than just that of the sampled recipients. Ideally, PSE would retroactively apply the results of the evaluation to the program year evaluated (2012), but the results of the evaluation were not finalized in time for filing savings as part of the annual report. Applying the results in the following program year is the next best option. Finally, the planned changes to Engagement event recipient data collection are a cost-effective way to improve certainty around PSE customer status for this small program.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.2.7. (g) Weatherization (not including MHDS)

This element of the E214 Single-family Existing program provides home insulation and double-pane windows. The BECAR methodology and findings are summarized in Table 30 and Table 31, respectively, followed by relevant details of the findings.

Table 30: E214g Program Review Methodology

Percentage of 2012-2013 portfolio savings	1.7%
BECAR level (low / medium / high)	Medium
RTF deemed savings review	Yes
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	No
Direct assessment	No

Table 31: E214g Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection for 25 sites; found no significant issues.
Impact evaluation	--
Direct assessment	--
Overall program	No significant issues uncovered.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the Weatherization sample.

On-site inspections

We inspected 25 Weatherization sites encompassing five different measure types. Thirteen of these sites have been previously inspected by the V-team. At four of the sites we conducted "meet-up" inspections.

Across the 25 sites we visited, we did not find any significant issues. We did find three issues worth noting here for the purpose of providing feedback that may be useful to PSE in their future inspections:

1. **Over-claimed window area.** At one 2012 Weatherization site we found the total window area at the site matches the rebate form and sales invoice; the PSE tracking database claims a larger area. The V-team field form does not record a "Finding," but lists an extra window which is not included in the sales invoice, resulting in a total window area greater than the tracking database.
2. **Under-claimed insulation area.** At another 2012 Weatherization site we found 1770 sq. ft. of attic insulation, which is consistent with the rebate form. The PSE tracking database evidently contains a typo because the area is listed at 170 sq. ft. This site was not inspected by the V-team.
3. **Over-claimed window area.** At one 2013 Weatherization site we found the total window area at the site (189 sq. ft.) matches the rebate form and sales invoice; however, likely due to a transcription error, the window area in the PSE tracking database (1891 sq. ft.) is off by a factor of ten. The energy saving tracked in the PSE database (39408 kWh) is therefore also high by a factor of ten. This site was previously visited by the V-team; they verified the actual window area (158 sq. ft. according to their notes) against the rebate and/or sales invoice and marked the site as a "match." But evidently the values in the PSE tracking database are not verified as part of the V-team review.

   Follow-up from the PSE V-Team:

   History: The V-Team staff received this job through CMS residential program team to verify 189 sq. ft. windows. The V-Team visited the site and marked it as "matched" in Vdatabase with a quantity of 158 sq. ft. From CSY, the systems channel then uploaded Vdatabase sq. ft. 158. There was a manual entry in CSY for 1891 sq. ft.

   V-Team Opportunity: Vdatabase should have marked the job as "finding."

   Rebates Process Opportunity: PSE should match data systems between CSY back up (which EES Tracks) and Vdatabase- to generate a report to confirm #'s match between CSY and Vdatabase.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.2.8. (h) Mobile Home Duct Sealing

This portion of the E214 Single-family Existing Weatherization program provides duct sealing services for mobile homes. The BECAR methodology and findings are summarized in Table 32 and Table 33, respectively, followed by relevant details of the findings.

Table 32: E214h Program Review Methodology

Percentage of 2012-2013 portfolio savings	0.9%
BECAR level (low / medium / high)	Low

RTF deemed savings review	Yes
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	No
Direct assessment	No

Table 33: E214h Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection for 2 sites; found no issues.
Impact evaluation	--
Direct assessment	--
Overall program	No issues uncovered.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the Mobile Home Duct Sealing sample.

Surveys and on-site inspections

We inspected two Mobile Home Duct Sealing sites; the sites included two different measure types, and one of the site visits was a "meet-up" inspection. We found no issues.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.2.9. (i) Home Energy Reports

This element of the E214 Single-family Existing program provides customized reports to help residential customers understand their energy usage and find ways to save. The BECAR methodology and findings are summarized in Table 34 and Table 35, respectively, followed by relevant details of the findings.

Table 34: E214i Program Review Methodology

Percentage of 2012-2013 portfolio savings	1.8%
BECAR level (low / medium / high)	Low
RTF deemed savings review	No
PSE deemed savings review	No

Surveys and on-site inspections	No
Impact evaluation	Yes
Direct assessment	No

Table 35: E214i Program Review Results

RTF deemed savings review	--
PSE deemed savings review	--
Surveys and on-site inspections	--
Impact evaluation	Evaluation found to be robust. PSE updated claim with evaluation results. Agree that future years (starting 2013) savings should include adjustment for upstream LEDs.
Direct assessment	--
Overall program	No issues uncovered.

Impact evaluation

In March 2013, DNV GL released the 4th year impact evaluation for Home Energy Reports (HERs), which covers the time period of 2009-2012.

The evaluation covered the first four years (2009-2012) of a randomized controlled trial in which 40,000 dual fuel, single family homes were randomly selected to be in a treatment group to receive home energy reports while 44,000 dual fuel, single family homes did not receive the reports and formed the control group. The treatment group received the reports either monthly or quarterly for the first two years. In the third year, 10,000 homes from the treatment group were randomly selected to stop receiving the reports which created a second treatment group to study persistence. Billing analysis was performed to develop an estimate of savings by comparing the annual consumption of the control group to the treatment group. After correcting for double-counting, the analysis calculated total savings for electric and gas of 6,959,625 kWh and 272,243 therms, respectively, across all homes in the treatment group. Electric and gas savings per household were found to be 300 kWh and 11 therms, or 2.8% and 1.3% of annual consumption, respectively, which was considered by the evaluator to be significant. As of the 2012 report, persistence results were inconclusive but fourth year savings were observed for both treatment groups.

The methodology of DNV GL's study is rigorous and comprehensive. PSE's Evaluation Report Response (ERR) for this study indicates PSE accepted the impact savings for 2012, noting that upstream LED bulb sales were not included and that in the following years the evaluation methodology should be expanded to include upstream LED lighting in the joint PSE program

savings. We think PSE's conclusion in the ERR not to attempt to estimate the savings impact for LEDs for 2012 is reasonable for the following reasons:

- Our review of 2012 upstream CFL and LED savings data indicates that LEDs represent about 13% of the combined CFL and LED upstream savings.
- The joint savings (savings attributed to other PSE programs) per household represent 2% of the HER gross savings per household for the current treatment group and 6% of the suspended treatment group. For the current treatment group, upstream savings represent 96% of the savings and rebate programs 4%. For the suspended treatment group, upstream savings represent 88% of savings and the rebate programs 12%.
- The electric joint savings were not statistically significant because they did not meet a 95% confidence level.

The 2013 evaluation report was not complete in time for review.

Status Update on ERR Action Items

An interview with the program manager, Joel Smith, regarding progress of action items in the ERR found that as of the 2013 evaluation they are continuing to review savings from households in the suspended group as well as including LEDs in the upstream analysis. Review of claimed savings confirmed that 2012 savings matched that of the 2012 evaluation.

Review Conclusions

The evaluator generally appeared to have used robust evaluation practices. Any concerns of the program manager and reviewer, e.g., double counting and upstream LEDs, are being addressed in the next round of evaluation. PSE claimed the results of the evaluation without modification for the 2012 program year. Since the evaluation is ongoing, the results of the 2012 evaluation are not applicable going forward. Thus no further adjustment to future savings claims based on the 2012 evaluation is necessary.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.3. E215 Single Family New Construction

This program provides rebates and incentives for efficient lighting, appliances, HVAC, water heating in new single-family residences, including manufactured homes. The BECAR methodology and findings are summarized in Table 36 and Table 37, respectively, followed by relevant details of the findings.

Table 36: E215 Program Review Methodology

Percentage of 2012-2013 portfolio savings	0.5%
BECAR level (low / medium / high)	Low
RTF deemed savings review	Yes

PSE deemed savings review	Yes
Surveys and on-site inspections	Yes
Impact evaluation	No
Direct assessment	No

Table 37: E215 Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection for 7 sites; found no significant issues.
Impact evaluation	--
Direct assessment	--
Overall program	No significant issues uncovered.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the Single Family New Construction sample.

PSE deemed savings review

As part of the Space Heating element of the Existing Single-family New Construction program, PSE incentivized an upgrade from standard efficiency air-source heat pump to a high efficiency unit. The PSE deemed savings values (Program UES) are shown in Table 38 along with the review team's recommended go-forward UES (Review Adjustment UES).

Table 38: UES for PSE deemed heat pump measures

Measure	Program UES (kWh/yr)	Review Adjustment UES (kWh/yr)
Air Source Heat Pump Tier #2	554	128

The savings for this measures was derived by Ecotope according to regionally accepted methods – using the SEEM simulation program with "last-in" assumptions.

When Ecotope developed the heat pump upgrade measures savings for PSE, the active RTF upgrade measures included duct sealing and commissioning. The RTF has since updated the heat pump upgrade measures to not require duct sealing or CC&S. Also, the baseline heat pump efficiency was updated by the RTF in August, 2010, to HSPF 8.5/SEER 14. New upgrade measures (with the exception of the highest efficiency, Tier 3, heat pump) based on these assumptions took effect in April, 2012.

On-site inspections

We inspected seven Single Family New Construction sites which included two measure types. Six of the sites have been previously inspected by the V-team. The other site was a “meet-up” inspection.

Across the seven sites we visited, we did not find any significant issues. We did find two issues worth noting here for the purpose of providing feedback that may be useful to PSE in their future inspections:

> **Unclaimed CFL fixtures.** At one Single Family New Construction site we found 12 Energy Star CFL indoor fixtures; the PSE tracking database lists only eight fixtures. The V-team field form records a “Match” and the comment reads "Energy Star lighting at 90%;” there is no record of the actual count on the V-team form.
>
> **Uninstalled CFL fixtures.** At another site we found nine Energy Star CFL indoor fixtures – two of which contained incandescent lamps. The PSE tracking database lists 11 Energy Star CFL fixtures. The V-team field form reads "Lighting 89%;” there is no record of the actual count on the V-team form.

Overall program

The review team found that PSE’s 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.4. E216 Single Family Fuel Conversion

This program provides incentives to replace electric space or water heating equipment with high-efficiency gas counterparts. The BECAR methodology and findings are summarized in Table 39 and Table 40, respectively, followed by relevant details of the findings.

Table 39: E216 Program Review Methodology

Percentage of 2012-2013 portfolio savings	0.5%
BECAR level (low / medium / high)	Low
RTF deemed savings review	No
PSE deemed savings review	Yes
Surveys and on-site inspections	Yes
Impact evaluation	No
Direct assessment	No

Table 40: E216 Program Review Results

RTF deemed savings review	--
PSE deemed savings review	Recommend adjustment on a go-forward basis for several measures.
Surveys and on-site inspections	Completed review and inspection for 7 sites; found no issues.

Impact evaluation	--
Direct assessment	--
Overall program	No issues uncovered.

PSE deemed savings review

These measures incentivize conversion from electric baseboard or electric forced-air space heat to high efficiency gas space heat, as well as conversion from electric water heat to high efficiency gas water heat. We reviewed the electric portion of the deemed savings. PSE UES values (Program UES) are shown in Table 41 along with the review team's recommended go-forward UES (Review Adjustment UES).

Table 41: UES for PSE deemed fuel conversion

Measure	Program UES (kWh/year)	Review Adjustment UES (kWh/year)
E2G Fuel Conversion – Space Heat -- Baseboard	8,500	10,500
E2G Fuel Conversion – Space Heat – Forced Air	8,500	10,500
E2G Fuel Conversion -- Water Heat	3,500	3,500
E2G FC -- Water and Space Heating -- Baseboard	12,000	14,000
E2G FC -- Water and Space Heating – Forced Air	12,000	14,000

The PSE deemed savings are based on PSE's 2005 Residential Characteristics Survey (RCS). Eligibility for this measure is restricted to homes with an annual electric consumption of at least 19,000 kWh. Until June, 2013, space heat savings were incremental according to home annual usage (based on energy bills). After that time, PSE claimed a flat amount – 8500 kWh/year, which was the amount associated with the 19,000 kWh/year home.

The PSE 2012 tracking database contains the distribution of claims for this measure shown in Table 42. Applying a weighted average to these claims results in a savings of 10,681 kWh/year for space heating (vs the 8500 kWh/year adopted by PSE in June 2013).

Table 42: 2012 tracking database distribution of fuel conversion space heating measures

Annual household electric usage (kWh/year)	Count of measures	Pre-June, 2013 Space heating savings (kWh)
19,000 – 20,000	28	8,500
20,000 – 22,500	19	10,250
22,500 – 25,000	3	12,750
25,000+	19	14,000

To confirm that the incremental values in the above distribution are reasonable, we compared the PSE savings values with space heating values taken from the RTF. Annual space heating usage, as derived with SEEM, for a 2200 sq. ft. home in Seattle is shown in the table below. These values are for the modeled "cost-effective" case, which is to say that the model assumes all cost-effective weatherization measures have been implemented. The values are therefore conservative. Values are also conservative because Seattle has a warmer climate than PSE territory overall.

Table 43: SEEM derived space heating usage (kWh/year) for 2200 sq.ft. home in Seattle

Zonal baseboard heat	9,968
Electric forced air furnace	11,433

The large number of homes adopting this measure with consumption greater than 25,000 kWh/year suggests that the average savings are significantly greater than 8500 kWh/year. The SEEM derived values are for an average-sized home. Based on the 2012 savings weighted average (10,681 kWh/year) derived from the data shown above in Table 42, and the conservative SEEM derived values shown in Table 43, we recommend that PSE should adjust their savings value to 10,500 kW/year for a minimum consumption of 19,000 kWh/year.

The PSE water heating savings of 3,500 kWh came directly from the RCS, which established an average usage of 3,474 kWh/year.

Standard RTF assumptions for water temperature, 45 gallons/day hot water usage, and energy factor of 0.94, yields an annual water heating usage of 3,119 kWh. For comparison, using DOE test procedure assumptions of 64 gallons/day results in an annual usage of 4,435 kWh. We therefore find the RCS value of 3,474 kWh to be reasonable because it falls within the range of the RTF-derived and DOE-derived savings values.

On-site inspections

We inspected seven Single Family Fuel Conversion sites which included four different measure types; two of the sites were V-team sites, and one site was a "meet-up" inspection. We found no issues.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented. The review team recommends adjustments on a go-forward basis for four measures.

3.3.5. E217 Existing Multifamily Residential

This program provides rebates and incentives for efficient lighting, appliances, HVAC, water heating, and improved building envelope components. The BECAR methodology and findings are summarized in Table 44 and Table 45, respectively, followed by relevant details of the findings.

Table 44: E217 Program Review Methodology

Percentage of 2012-2013 portfolio savings (projected)	6.3%
BECAR level (low / medium / high)	Medium
RTF deemed savings review	Yes
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	Yes
Direct assessment	No

Table 45: E217 Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection for 21 sites; found one minor issue.
Impact evaluation	Review in progress.
Direct assessment	--
Overall program	No major issues uncovered.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the Multi Family Existing sample.

On-site inspections

We inspected 21 Multi Family Existing sites which included 13 different measure types. Eight of the sites have been inspected previously by the third-party implementer and/or V-team.

Across the 21 sites we visited, we did not find any significant issues.

At one site, our inspection confirmed that a finding by the V-team (32 common area lighting fixtures instead of 33) had been correctly identified and resolved; this is a good example of the effectiveness of the V-team inspection process.

Impact evaluation

SBW conducted an evaluation of this program in 2011. To avoid conflict of interest, DNV GL reviewed the evaluation.

Building shell measures were evaluated under a calibrated building simulation analysis approach using eQUEST Version 3.64. Program installation data for non-shell measures[27] suggested these measures did not provide significant savings relative to the entire program savings and so a comparison and review of the PSE deemed measure savings was performed in place of an energy savings impact evaluation. For the building simulation, participant building characteristic and measure data was sourced from PSE project files, and design document plans from municipal planning/building departments or building owners. For the purpose of model calibration, the PSE monthly or bimonthly electric and gas billings records for all sample participants were gathered and a post-retrofit calibration period of October 2009 to September 2010 was selected. Two calibrated participant model prototypes were created: one represented sample sites with electric space heat, while the other represented sites with gas space heat. The sample frame was drawn from the program database, which was filtered to exclude the smallest savers resulting in 149 sites with one or more measures implemented. From this sample frame, PSE and the evaluation team agreed upon an allocation of 12 sample sites for electric savers (representing 106 sites) and 8 sample sites for gas savers (representing 43 sites). The evaluation provided estimates of annual energy savings from building shell measures in 2007-2009 program year, normalized by retrofit area (e.g., ft2), as well as future savings estimates broken out by the combination of pre-retrofit to post-retrofit wall or window R and U-values and space heat fuel type.

The report and appendix provides details on the use of a calibrated participant model prototype which infers certain assumptions. The RTF prototype and other referenced prototypes such as the DEER models are created to represent typical multifamily buildings. The prototype in the PSE MF Existing evaluation is an aggregation of the sampled buildings and therefore has dimensions much larger than the average multifamily building in the program or in PSE service territory. Using the word prototype for the aggregated model may be unclear since RTF and other “prototypes” are scaled to represent a typical or average building.

Reviewing the modeling approach there are two technical concerns. The first concern is the model construction and the second is the calibration. In general, the data sources used for baseline and internal loads appear to be reasonable. There are a few details not listed in the Appendix like infiltration rates or explanation source of the lighting wattage (different in the electric and gas model). The focus is on the two concerns as those other details should have minimal effect on the weatherization results.

For the model construction, the point is made by the report that eQuest can model multiple zones while SEEM cannot. What is unclear is that since the evaluation model appears to be an aggregation of sampled buildings the zonal interactions are unknown. The orientations (North, East, South, West) of the sampled buildings are not described and the wall and window areas for each orientation of the prototype are not specified. The savings for windows would be greatly affected by changing orientation and shifting loads will affect the results of the other heat transfer surfaces. The amount of common area in the sample and the prototype is

[27] Ductless heat pumps, in-unit gas furnaces, refrigerators, electric storage water heaters, and gas storage water heaters.

unknown and if present only modeling the tenant units will produce different results as these areas may have different thermostat schedules than tenant spaces.

For the calibration, it appears the pre-retrofit bills were available but not used. Since the building characteristics were taken from the BPA study in many cases, using the pre-retrofit bills to calibrate the baseline would have been a better approach to establish baseline consumption. Also, it is unclear why EUI's are used when the bills are from each sampled building and the prototype is an aggregation of the buildings. If each zone was representative of a sampled building then the total bill could be used for calibration. Using average EUI's and comparing that to the model total use divided by total floor area gets rid of the correlation between different levels of shell measure efficiency and the consumption for that sampled building.

Calibration is a labor intensive undertaking and the approach appears to minimize that process. Additionally, there is no discussion about the process of extrapolating from the sample to the program population. The chosen approach makes it impossible to estimate the sample variance and sampling uncertainty directly since all sample points are part of the aggregated model. At a minimum the variance in the model inputs and the EUI's should have been summarized and then a subsequent propagation of error analysis could be used as a proxy to estimate uncertainty in the final results.

Aside from the concerns of the approach used there is one element missing. Change in infiltration due to the measures is not discussed and therefore it is assumed that infiltration is the same in the baseline and as-built cases. The assumption that insulation and window measures do not affect infiltration is incorrect because infiltration points may be sealed by the added insulation or around new windows. This means there is some additional savings associated with the shell measures beyond their heat transfer effects.

Status Update on ERR Action Items

In the PSE Evaluation Report Response (ERR), the Multifamily Weatherization Program Team (John Forde, Sandy Sieg, Clint Stewart, and Bobette Wilhelm) reviewed the evaluation results from the SBW report and felt PSE's best interest was to follow the directive of the RTF; not the directive of the report from SBW for the unit energy savings. There were two primary concerns.

1. The realization rates for measures varied significantly. For the majority of offerings, the SBW evaluation estimates a value of savings which is much higher than current RTF estimates for the same measures. Windows is the only exception to this rule. For Windows, the SBW study estimates a value of savings which is much lower than the current RTF estimates.
2. SBW's savings estimates are derived from a prototype model building- a building which is unlike any building in PSE service area. PSE program management and evaluation staff repeatedly asked SBW for a description of the prototype building.

Review Conclusions

The conclusions from the independent review are that model used was unlike prototypes used by the RTF and others and this was the source of PSE's confusion in trying to understand the

model. Since the aggregated approach to the model is not typical in other evaluations, there are a few other concerns not addressed in the report. The last RTF document provides recommendations to update the RTF SEEM models and keep the models as representing 12 and 24 unit buildings. This recommendation seems appropriate and would address PSE's concern with using the aggregated eQuest model used in the evaluation. The recommendation includes using additional studies and calibrating the updated models. There was an approach approval and recommendations after the original "out of compliance" disposition, but it is not clear if the update will be completed in time for PSE to use in future programs.

The final recommendation is for PSE to revise and calibrate the RTF SEEM 12 and 24 unit prototypes consistent with the recommendation by SBW to the RTF. Data from the 2011 evaluation can be used in lieu of new data to save costs and new values could be produced quicker than the RTF cycle if PSE needs new values. An alternative would be to revise the eQuest models to be configured more similar to the typical MF buildings rather than an aggregated model. This alternative of a revised eQuest models cannot refute PSE's decision because there are concerns with both the old RTF savings and the 2011 reported savings. Therefore, the recommended solution would be to use the data in the past study (and potentially other studies completed since) and do a revision of either the RTF SEEM or the 2011 evaluation eQuest models. The evaluation's intent was to end up with unit energy savings for each ECM, but this means that the results may be sufficient on a program level to make averaged savings claims, but will not be able to determine if it is a cost effective measure to implement on a specific site.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.6. E218 Multifamily New Construction

This program provides rebates and incentives for efficient lighting, appliances, HVAC, water heating, and improved building envelope components in new multi-family residences. The BECAR methodology and findings are summarized in Table 46 and Table 47, respectively, followed by relevant details of the findings.

Table 46: E218 Program Review Methodology

Percentage of 2012-2013 portfolio savings (projected)	0.3%
BECAR level (low / medium / high)	Low
RTF deemed savings review	Yes
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	No
Direct assessment	No

Table 47: E218 Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection for six sites; found no issues.
Impact evaluation	--
Direct assessment	--
Overall program	No issues uncovered.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the Multi Family New Construction sample.

On-site inspections

We inspected six Multi Family New Construction sites which included ten different measure types. All six of the sites have been inspected previously by the V-team. We found no issues, and our findings are consistent with the V-team at all five sites.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.7. E250 Commercial/Industrial Retrofit

This program provides incentives for upgrades to equipment (lighting, HVAC, refrigeration, etc.), building shell, industrial process, and select operations and maintenance improvements. It includes both Custom Grant subprograms, such as Energy Smart Grocer and Comprehensive Building Tune-Up (CBTU), and Contracted subprograms, such as Data Center Efficiency (DCEEP) and Industrial Systems Optimization (ISOP). The BECAR methodology and findings are summarized in Table 48 and Table 49, respectively, followed by relevant details of the findings.

Table 48: E250 Program Review Methodology

Percentage of 2012-2013 portfolio savings (projected)	20.7%
BECAR level (low / medium / high)	Low-Medium
RTF deemed savings review	No
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	Yes
Direct assessment	No

Table 49: E250 Program Review Results

RTF deemed savings review	--
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection for 18 sites; found no issues.
Impact evaluation	Evaluation found to be rigorous and comprehensive. Realization rate of 100% indicates that PSE's savings estimation methods are sound. No changes to savings claim recommended.
Direct assessment	--
Overall program	No issues uncovered.

On-site inspections

We inspected 16 C/I Retrofit sites. The sites included standard retrofits, controls -based retrofits, Comprehensive Building Tune-up, Energy Smart Grocer Rebate, and Data Center Efficiency; we found no issues.

We also conducted “desk reviews” of two Simplified Building Tune-Up projects; we found no issues.

Impact evaluation

Note: The Impact Evaluation for E250-Commercial/Industrial Retrofit was part of a joint evaluation of E250, E258 and LED Traffic Signals programs; therefore the discussion in this section is repeated (for the most part) under the Impact evaluation section for E258.

The evaluation covered the Commercial and Industrial (C&I) Retrofit, Large Power User (LPU) Self-Directed, and LED Traffic Signals programs in the 2009-2010 program years. This review focused on the impact evaluation of electric savings for these programs. The two programs were evaluated as one due to the similarity of measure mix and program delivery.

The evaluator first reviewed evaluation best practices to inform evaluation methodology. Subsequently, they prioritized measures and reviewed project files to establish a sampling framework and assign rigor level. Prioritization incorporated distribution of claimed savings, measure savings uncertainty, and PSE interest. The highest priority measures were subjected to enhanced rigor using evaluation methodology consistent with IPMVP protocol such as end-use metering. Medium priority measures received algorithm-based savings calculations based on verification of equipment installation and spot measurement. Low priority measures received engineering review of project files including comparison of input assumptions to industry standards. The sample design used the stratified ratio estimation approach based on the assumption that the variance of each project’s realization rate is generally much smaller than the variance of the magnitude of each project’s savings. The evaluator assumed a coefficient of variation (CV) of 0.4. The stratified sample design targeted 10% precision at 90% confidence across both programs and program years resulting in a total sample size of 42 representing 10% of population savings across 5 measure category strata.

The evaluator found the realization rate to be 102% at confidence/precision of 90/10 for the combined program level and lighting measure category with the remaining measure categories at least 80/20. The evaluator also provided two additional realization rates to isolate the effects of accuracy in savings calculations and the impacts of economic volatility, which came in at 106% and 99%, respectively. These high realization rates reflect the accuracy of PSE's original estimation of savings.

Overall, the evaluation appeared rigorous and to follow best practices. However, regarding the sample design, the evaluator states that the CV is based on previous evaluation experience. A stronger, more credible case would be established if they had provided more specific information about the derivation of the assumed CV. Furthermore, the evaluator could have reported the actual CVs of this evaluation to compare against the assumed CV and for future reference.

Status Update on ERR Action Items

Since the evaluation found PSE's savings calculations methods to be sufficiently accurate, there were no recommendations or follow-up actions that directly affect savings claims going forward. However, the evaluator made several important recommendations regarding data collection and tracking standardization. A follow-up interview with the program management team revealed that PSE has addressed these recommendations by developing standardized tools and data requirements which provide consistency and transparency in data collection and savings calculations. Additionally, the CSY database has been enhanced to support program management activities including more effectively managing the workload distribution of Quality Control reviewers which helps to mitigate bottlenecks in project flow. Furthermore, PSE has implemented a standardized project file system on the network that captures all project documentation electronically.

Also, PSE addressed all of the recommendations out of the Process Evaluation. Notably, they initiated focus groups with stakeholders in the BEOP (now CBTU) program which resulted in simplified incentives and clarified documentation requirements. A pilot Third Party Commissioning program in 2012-13 for small businesses did not meet their expectations and was not continued. A review of the RTF Standard Protocols found that none were applicable to C&I Retrofit but they are continuing to monitor the development of the RTF protocols. A new marketing team and strategy has been in place since the evaluation and includes social media-type outreach to attract and inform trade allies; meanwhile, EMEs have continued attending trade ally events. Additionally, the roll out of the new CIS was completed in April 2013 but program staff experienced difficulty integrating with their systems to meet their needs. They are currently looking at alternative platforms. Furthermore, the ESG program was expanded to include gas measures as well as new construction.

On the whole, PSE appears to have been proactive in improving program operations based on the guidance of the evaluation recommendations.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.8. E251 Commercial/Industrial New Construction

This program provides incentives for efficiency upgrades that exceed codes or standard practice for new facilities or major remodels of all sizes. The BECAR methodology and findings are summarized in Table 50 and Table 51, respectively, followed by relevant details of the findings.

Table 50: E251 Program Review Methodology

Percentage of 2012-2013 portfolio savings (projected)	1.2%
BECAR level (low / medium / high)	Low
RTF deemed savings review	No
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	Yes
Direct assessment	No

Table 51: E251 Program Review Results

RTF deemed savings review	--
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspect of 1 site; no major issues found.
Impact evaluation	Suggest improvement to reporting/documentation of evaluation activities.
Direct assessment	--
Overall program	No issues uncovered.

On-site inspections

At the one site we visited, we did not find any significant issues. We did find two issues worth noting here for the purpose of providing feedback that may be useful to PSE in their future inspections:

1. **Possible over-claimed savings for lighting fixtures plus controls.** Our inspection of a C/I New Construction site (Grant Agreement Number: C-11756) found approximately the same number of LED fixtures (222) as PSE found during their previous inspection (233); however, both counts differed from the proposed quantity (184) listed in the project file. (Note: because this is a custom calculation, the measure quantity listed in the tracking database is one, not the number of LED fixtures). The project documentation includes savings calculations for only a portion of the LED/OS measure; the database annual savings are considerably greater (159,987 kWh) than this partial savings (52,394). The difference in fixture counts would not be expected to account for this difference in savings.

2. **Possible under-claimed savings for refrigeration anti-sweat heaters.** Our inspection of the C/I New Construction site discussed in the paragraph above found the anti-sweat to heaters to operate approximately 12% of the time. Based on the documentation provided for this measure, it appears that the savings are based on 50% anti-sweat heater on-time, suggesting the true savings could be increased beyond the calculated savings. It is not clear how the claimed savings were arrived at, but they appear to substantially understate the actual savings by as much as 36%. Project file and door counts at the site are in agreement.

Impact evaluation

The evaluation covered the Whole Building, Component Measure, and New Construction Commissioning approaches in the Commercial and Industrial (C&I) New Construction program. This review focused on the impact evaluation of electric savings.

The evaluator sought to quantify savings and develop realization rates for each of the above program approaches via review of tracking systems, secondary and best practices literature, project files and Measurement and Verification of a sample of projects. The tracking system review informed prioritization of measures for the sampling framework. In addition to the target of 90/10 confidence/precision for program approach level realization rates, high priority measures had a target of 80/20 confidence/precision. The sample design used the stratified ratio estimation approach based on the assumption that the variance of each project's realization rate is generally much smaller than the variance of the magnitude of each project's savings. The evaluator assumed a coefficient of variation (CV) of 0.4. This resulted in a total sample size across the three program approaches of 34 out of 76 electric projects[28]. Project file reviews involved collection and review of all critical input files and supporting documents, baseline and as-built model review, post-occupancy billing data review, and savings model calibration and calculation. On-site measurement and verification followed the IPMVP protocols and included spot measurements as well as data logging or trending when deemed necessary. The evaluation yielded realization rates at over 100% for each program approach indicating that, if anything, PSE is overly conservative in their savings estimations. Notably, the New Construction Commissioning approach had a realization rate of 271% because the evaluation increased the savings percentage assumed by PSE of 5% up to the industry standard of 13%. However, this particular approach has shifted significantly in delivery from design and construction commissioning to post- occupancy commissioning so PSE does not believe the savings percentage, nor the realization rate, is applicable going forward.

Overall, the evaluation likely followed evaluation best practices but the report is scant on some critical details to confirm. The report provided insufficient documentation of evaluation activities. For example, there was no further documentation of secondary literature or best practices review beyond initial mention of it in the evaluation scope. The report should state what the references were and how those references informed the evaluation. Additionally, the report was unclear as to whether the evaluation included file reviews of all projects or only

[28] Sample size combined across electric and gas projects so we could not tell how many electric projects were sampled.

sampled projects. Furthermore, it was somewhat ambiguous if all sampled projects received on-site M&V or only "as needed". If the latter, the report should indicate how many of the sampled projects received full M&V. Generally, the report contained many instances of unqualified and/or unquantified loose language such as "as needed" and "where possible" as if it was leftover from the work plan and not updated with actuals for the evaluation report. Moreover, regarding the sample design, the evaluator states that CVs are based on previous evaluation experience. A stronger, more credible case could have been established if they had provided more specific information about the derivation of the assumed CVs. Furthermore, the evaluator could have reported the actual CVs of this evaluation to compare against the assumed CVs and for future reference.

Status Update on ERR Action Items

PSE finalized the ERR at the end of 2013. In the short time that has elapsed, they have already addressed many of the recommendations. In particular, significant progress has been made on the Impact recommendations which primarily involved standardizing data collection and documentation requirements and transparency of savings calculations. They addressed the majority of the issues by initiating an overhaul of the Quality Control Checklist to formalize requirements for reviewing baseline and other assumptions, methodology, and EUI reasonableness as well as confirming, when relevant, presence of the energy model in the electronic project file. Furthermore, the program manager reported that they are currently putting together a team to establish standard participant data requirements, focusing on trend data.

Review Conclusions

Due to the deficiencies cited regarding documentation, we do not have high confidence in the realization rates. The evaluation revealed several opportunities to improve internal documentation which PSE has already begun to implement. Going forward, PSE should continue to implement the evaluation recommendations and ensure that evaluations follow industry best practices supported by well-documented evaluation reporting.

Overall program

The review team suggests improvement to reporting/documentation of evaluation activities.

3.3.9. E253 Resource Conservation Manager Services

This program provides grants for large customers with multiple facilities to hire a dedicated resource manager to reduce energy use by 10% or more over a three-year term. The BECAR methodology and findings are summarized in Table 52 and Table 53, respectively, followed by relevant details of the findings.

Table 52: E253 Program Review Methodology

Percentage of 2012-2013 portfolio savings	4.7%
BECAR level (low / medium / high)	Medium

RTF deemed savings review	No
PSE deemed savings review	No
Surveys and on-site inspections	No
Impact evaluation	Yes
Direct assessment	No

Table 53: E253 Program Review Results

RTF deemed savings review	--
PSE deemed savings review	--
Surveys and on-site inspections	
Impact evaluation	No issues.
Direct assessment	--
Overall program	No issues uncovered.

Impact evaluation

In order to assess the evaluation, RIA reviewed SBW's program evaluation report, which included the Evaluation Response Report (ERR), and interviewed PSE's program manager about program changes that may influence the applicability of the evaluation findings to the ongoing program.

RIA found that the evaluation produced recommendations designed to:

- Improve the program's savings realization rates. Recommendations included requiring more detailed project documentation and quarterly project reporting; improving billing analysis, Energy Interval and Utility Manager software applications, and aggregation of weather station data; and employing a fixed baseline approach to estimate savings. The program has begun to implement some of these recommendations and is developing program modifications consistent with the remaining recommendations.
- Capture additional energy savings and non-energy benefits (NEB), which SBW estimates could offset 50% of program costs. Recommendations included using a fixed baseline approach to estimating savings, and developing strategic partnerships with other resource conservations organizations to help RCMs document and determine approaches to assign value to savings from NEB sources. The program is implementing these recommendations.
- Improve participant satisfaction and reduce customers' perceived risks involved with participation. Recommendations included increasing RCMs' access to training through online training applications, reducing perceived risks by a pay-for-performance incentive

structure,[29] and providing a 'turn-key' solution whereby PSE supplies and supervises RCM staff. The program is developing program modifications consistent with all of these recommendations.

SBW reported realization rates of 85% for electric, 70% for natural gas, and 81% for the combined energy savings; the calculated error for these estimates was 31% for electric and 34% for natural gas. SBW attributed the realization rates' shortfall from 100% to the lack of documentation of RCM activities for savings claimed for some project sites, and the moderately high error estimates to the high variation in realization rates.

Evaluation Methodology

SBW used random stratified sampling to help reduce estimation errors, and project-specific analysis approaches, either top-down or bottom-up analysis,[30] to provide maximal precision. The impact team drew a sample of 13 projects with positive savings estimates, and 4 projects with negative savings.[31] The sampling and estimation approaches are consistent with good evaluation practices.

Review Conclusions

We found that the evaluation made several recommendations designed to improve program realization rates, capture additional savings currently generated by projects with long measure lives, and improve participant satisfaction and willingness to participate in the program. We also found that the program is making changes in response to all of these recommendations. Key program changes include implementation of fixed baseline savings estimation protocols, and improvements to project documentation through new program requirements and program software upgrades.

We concluded that the impact team employed methods that provided maximal precision relative to the sample and the available project information. We do not recommend any further sampling and analysis that might be undertaken with the aim of reducing the realization rate estimation error. We think that the value of such information does not warrant its cost, given that the estimated program savings comprise 5.2% of PSE's portfolio. The program is implementing recommended changes that should improve its realization rate and, as a consequence, the estimation error.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

[29] During the evaluation period, the program provided a flat incentive for RCM sites that achieved savings targets, and did not include savings from capital projects. The program plans to modify its incentive structure to a pay-for-performance structure with bonus incentives for RCM sites that achieve targets. The plan will allows program participants to count energy savings from capital projects toward the bonus incentive.

[30] The top-down analysis reassessed projects' program billing analysis savings estimates, and bottom-up approaches quantified savings from engineering calculations and modeling of specific RCM actions.

[31] The program did not claim savings from projects with negative savings estimates. The impact team sampled these projects to document the causes of negative savings.

3.3.10. E255 Small Business Lighting Rebate

This program provides rebates for a wide range of lighting conversions in small businesses. It also provides a contractor and vendor network. The BECAR methodology and findings are summarized in Table 54 and Table 55, respectively, followed by relevant details of the findings.

Table 54: E255 Program Review Methodology

Percentage of 2012-2013 portfolio savings	4.2%
BECAR level (low / medium / high)	Medium
RTF deemed savings review	No
PSE deemed savings review	Yes
Surveys and on-site inspections	Yes
Impact evaluation	Yes
Direct assessment	No

Table 55: E255 Program Review Results

RTF deemed savings review	--
PSE deemed savings review	Adjustment recommended to LED measures.
Surveys and on-site inspections	Completed review and inspection for 9 V-team sites; found no issues.
Impact evaluation	Suggest site visits and improvement to reporting/documentation of evaluation activities in future evaluations of this program.
Direct assessment	--
Overall program	Adjustments recommended to PSE deemed savings values for LEDs.

PSE deemed savings review

LED Lighting

Refer to the PSE deemed savings review, LED lighting, in Section 3.3.12. The LED lighting measures included in the E255-Small Business Lighting program are the same as the LED lighting measure included in the E262-Commercial Rebate, MCFL and CONR programs.

CFL Lighting

The PSE deemed savings values (Program UES) are shown in Table 56. These values include the June, 2012, updates (10% storage rate, decreasing the savings by 10%).

Table 56: UES for PSE deemed commercial CFL's

Measure	Program UES (kWh/yr)
Less than 26 Watts	139
26 to 39 Watts	149
Greater than or equal to 40 Watts	209

Baseline and measure lamp watts were derived from PSE installations of CFL's at commercial sites from 2000-2008. Hours of operation were also derived from the selection of previous installations.

PSE provided SBW with a list of CFL measures used as the basis of savings. However, we were unable to completely verify the program savings values, in part because we could not definitively assign watts to each measure. However, the values we calculated were close to program savings.

SBW compared program savings with lumen-equivalent savings as well as possible given the limited number of savings bins**.** Table 57 shows the difference between the original program savings and lumen equivalent savings.

Table 57: Lumen equivalent CFL savings compared with program savings

Nominal wattage of lamp to be replaced	Post EISA 2012-2014 Incandescent wattage	CFL Wattage	Hours of Operation (Average of CBSA)	2012 Lumen equivalent Savings	Program Savings
40	29	11	4108	119	139
60	43	14	4108	189	139
75	53	20	4108	226	139
100	72	25	4108	193	139
150	150	42	4108	444	209

In general, program savings are less than expected lumen-equivalent savings. However, the program savings bin, "less than 26 watts," applies to all incandescent baseline lamps less than 100 watts, which makes comparison difficult.

The most recent RTF residential CFL measure includes a percentage of CFL's in the baseline. This would be reasonable for commercial CFL's as well, given the high saturation of CFL's in commercial settings. This approach is also used for PSE's commercial LED measure.

We did not attempt to create a table of recommended savings for this measure. We do not have enough information to derive savings values that match the original PSE savings bins. Our recommendation is to add savings bins to match lower lumen lamps. In addition, the baseline

should clearly depend on the delivery mechanism. Where the pre-existing lamp type and wattage can be recorded, the baseline can be halogen. Otherwise, the baseline should be a mix of halogen and CFL's, as in the commercial LED measure. Savings would be best derived based on lumen equivalence.

On-site inspections

We inspected 15 Small Business Lighting Rebate sites. Thirteen of the sites have been previously visited by the V-team, and two of the site visits were "meet-up" inspections.

We found no issues. Our findings are consistent with the V-team at all sites; this includes one site where our inspection confirmed that the issues initially discovered by the V-team have been correctly resolved.

Impact evaluation

Note: The Impact Evaluation for E255-Small Business Lighting was part of a joint evaluation of E255 and E262-Commercial Rebate; therefore the discussion in this section is repeated (for the most part) under the Impact evaluation section for E262.

The evaluation report was not finalized in time so a draft hard copy was supplied by PSE for this review which focused solely on the impact evaluation of electrical savings. The evaluator sought to verify claimed savings and establish realization rates for the 2011-2012 evaluation period using engineering reviews of sampled project documents and on-site inspection as deemed necessary. Additionally, the evaluator reviewed documentation on all projects to examine how well PSE enters and tracks savings internally as well as PSE's business cases which establish prescriptive measure savings and custom savings calculation methods. The engineering review sample design used the stratified ratio estimation approach based on the assumption that the variance of each project's realization rate is generally much smaller than the variance of the magnitude of each project's savings. Coefficients of variation (CVs) assumed were in the range of 0.3 to 0.6, low end of the range for more certain non-control lighting measures and top end for less certain custom measures. The sample design targeted 10% precision at 90% confidence at the program level and 20% precision at 80% confidence at the measure stratum level. The former was achieved for both programs while the latter was achieved for all measure strata except "All Other" in Commercial Rebates which accounted for 18% of that program's savings. The project documentation review yielded realization rates of just over 100% for both programs indicating that PSE accurately tracks savings. The engineering review included on-site inspection for HVAC, motor and hot water uses. Furthermore, if other measures were present at sites with sampled measures, the additional measures were evaluated as well. The resulting realization rate was 91.6%. The deviation from 100% was due to a low realization rate on the Pre-Rinse Spray Valve measure stratum because of low in-service rates of faucet aerators as well as a downward adjustment to the prescriptive savings value.

Overall, the evaluation likely followed evaluation best practices but the report is scant on some critical details to confirm thus the evaluation rigor appears sub-standard. Regarding the sample design, the evaluator states that CVs are based on previous evaluation experience. A stronger, more credible case could have been established if they had provided more specific information about the derivation of the assumed CVs. Furthermore, the evaluator could have reported the

actual CVs of this evaluation to compare against the assumed CVs and for future reference. Concerning engineering review, the evaluator performed on-site inspection for measures representing less than half of Commercial Rebates total electric savings. In particular, there were no on-sites for lighting measures, regardless of whether controls were involved, including all of the sampled Small Business Lighting projects. The evaluator excused the latter away since PSE does its own verification, but without better explanation this seems to runs counter to best practices in impact evaluation. Moreover, beyond a general statement that they followed IPMVP protocol, the report provided insufficient information about specific practices they followed to re-estimate savings and review business cases for the various affected measures such as how baseline and current operating parameters were verified, when metering or trend data were used to inform inputs, or if a different savings algorithm was applied.

Status Update on ERR Action Items

Since an ERR was not ready in time for this review, we interviewed the program manager and evaluation team about the recommendations in the evaluation report that impact savings going forward.

Improve documentation practices: the evaluator suggested standardization of business case development and record keeping

The program manager responded that they have standardized the Measure:Metrics business case development process and increased the rigor of analysis, with an Energy Management Engineer QC review process now required to validate engineering assumptions and analysis approach. Additionally, all cited references are retained in M:M to ensure they are available for review at a later date. Furthermore, increased emphasis is being placed on capturing all secondary data sources (project files, etc.) and retaining them in the M:M repository.

Review Conclusions

The evaluator mentioned several times throughout the report constraints on budget and time preventing a more thorough, rigorous evaluation. Examples of the impacts of the constraints include smaller sample sizes, less on-site inspection, and less metering. Due to the deficiencies cited regarding documentation and evaluation practices, we do not have high confidence in the realization rates. That said, the evaluation revealed several opportunities to improve savings estimations which PSE has already begun to implement. Going forward, PSE should continue to implement the evaluation recommendations and ensure that evaluations follow industry best practices supported by well-documented evaluation reporting.

Overall program

The PSE deemed UES values for LEDs and CFLs should be adjusted on a go-forward basis.

Note: The Small Business Lighting program ended on December 31, 2013, and therefore, there is nothing to apply in 2014. PSE is closing out projects submitted by December 31, 2013 using practices that were in place at that time. The program is to be fully shut down by June 30, 2014.

3.3.11. E258 Large Power User – Self Directed

In this program, large commercial and industrial customers submit proposals for efficiency upgrades using the funds allocated by their tariff. The BECAR methodology and findings are summarized in Table 58 and Table 59, respectively, followed by relevant details of the findings.

Table 58: E258 Program Review Methodology

Percentage of 2012-2013 portfolio savings	5.2%
BECAR level (low / medium / high)	Medium
RTF deemed savings review	No
PSE deemed savings review	No
Surveys and on-site inspections	Yes
Impact evaluation	Yes
Direct assessment	No

Table 59: E258 Program Review Results

RTF deemed savings review	--
PSE deemed savings review	--
Surveys and on-site inspections	Completed review and inspection for 4 sites; found no issues.
Impact evaluation	Evaluation found to be rigorous and comprehensive. Realization rate of 100% indicates that PSE's savings estimation methods are sound. No changes to savings claim recommended
Direct assessment	--
Overall program	No issues uncovered.

On-site inspections

We inspected four Large Power User Self-Directed sites. The sites were actually four different buildings at one large facility. The measures were fan VFDs and HVAC controls; we found no issues.

Impact evaluation

Note: The Impact Evaluation for E258-Large Power User-Self Directed was part of a joint evaluation of E250, E258 and LED Traffic Signals programs; therefore the discussion in this section is also included (for the most part) under the Impact evaluation section for E250.

The evaluation covered the Commercial and Industrial (C&I) Retrofit, Large Power User (LPU) Self-Directed, and LED Traffic Signals programs in the 2009-2010 program years. This review

focused on the impact evaluation of electric savings for these programs. The two programs were evaluated as one due to the similarity of measure mix and program delivery.

The evaluator first reviewed evaluation best practices to inform evaluation methodology. Subsequently, they prioritized measures and reviewed project files to establish a sampling framework and assign rigor level. Prioritization incorporated distribution of claimed savings, measure savings uncertainty, and PSE interest. The highest priority measures were subjected to enhanced rigor using evaluation methodology consistent with IPMVP protocol such as end-use metering. Medium priority measures received algorithm-based savings calculations based on verification of equipment installation and spot measurement. Low priority measures received engineering review of project files including comparison of input assumptions to industry standards. The sample design used the stratified ratio estimation approach based on the assumption that the variance of each project's realization rate is generally much smaller than the variance of the magnitude of each project's savings. The evaluator assumed a coefficient of variation (CV) of 0.4. The stratified sample design targeted 10% precision at 90% confidence across both programs and program years resulting in a total sample size of 42 representing 10% of population savings across 5 measure category strata.

The evaluator found the realization rate to be 102% at confidence/precision of 90/10 for the combined program level and lighting measure category with the remaining measure categories at least 80/20. The evaluator also provided two additional realization rates to isolate the effects of accuracy in savings calculations and the impacts of economic volatility, which came in at 106% and 99%, respectively. These high realization rates reflect the accuracy of PSE's original estimation of savings.

Overall, the evaluation appeared rigorous and to follow best practices. However, regarding the sample design, the evaluator states that the CV is based on previous evaluation experience. A stronger, more credible case would be established if they had provided more specific information about the derivation of the assumed CV. Furthermore, the evaluator could have reported the actual CVs of this evaluation to compare against the assumed CV and for future reference.

Status Update on ERR Action Items

Since the evaluation found PSE's savings calculations methods to be sufficiently accurate, there were no recommendations or follow-up actions that directly affect savings claims going forward. However, the evaluator made several important recommendations regarding data collection and tracking standardization. A follow-up interview with the program management team revealed that PSE has addressed these recommendations by developing standardized tools and data requirements which provide consistency and transparency in data collection and savings calculations. Additionally, the CSY database has been enhanced to support program management activities including more effectively managing the workload distribution of Quality Control reviewers which helps to mitigate bottlenecks in project flow. Furthermore, PSE has implemented a standardized project file system on the network that captures all project documentation electronically.

A review of the RTF Standard Protocols found that none were applicable to C&I Retrofit but they are continuing to monitor the development of the RTF protocols. A new marketing team and strategy has been in place since the evaluation and includes social media-type outreach to attract and inform trade allies; meanwhile, EMEs have continued attending trade ally events. Additionally, the roll out of the new CIS was completed in April 2013 but program staff experienced difficulty integrating with their systems to meet their needs. They are currently looking at alternative platforms. On the whole, PSE appears to have been proactive in improving program operations based on the guidance of the evaluation recommendations.

Overall program

The review team found that PSE's 2012-13 savings claim for this program is sound, defensible, and well-documented.

3.3.12. E262 Commercial Rebate

This program provides standardized rebates for common, relatively uniform measures in various areas, such as cooking equipment, interior lighting, and heat pumps. The BECAR methodology and findings are summarized in Table 60 and Table 61, respectively, followed by relevant details of the findings.

Table 60: E262 Program Review Methodology

Percentage of 2012-2013 portfolio savings	11.7%
BECAR level (low / medium / high)	Low-High
RTF deemed savings review	Yes
PSE deemed savings review	Yes
Surveys and on-site inspections	Yes
Impact evaluation	Yes
Direct assessment	No

Table 61: E262 Program Review Results

RTF deemed savings review	Reviewed the measures; found no issues.
PSE deemed savings review	Adjustment recommended for LED measures.
Surveys and on-site inspections	Completed review and inspection for 78 sites; found no major issues.
Impact evaluation	Suggest improvement to reporting/documentation of evaluation activities in future evaluations of this program.
Direct assessment	--
Overall program	Adjustments are recommended for PSE deemed UES for LEDs.

RTF deemed savings review

We found no issues regarding the application of the UES values for the RTF deemed measure types in the Commercial Rebate sample.

PSE deemed savings review

LED Lighting: Commercial Lighting Rebate (CONR), Commercial Lighting Markdown (MCFL), and Small Business Direct Install (SBDI) programs

For CONR and MCFL, the PSE deemed savings values (Program UES) are shown in Table 62 along with the recommended go-forward UES (Review Adjustment UES).

The PSE values shown in the table below include updates that were made in 2012, to account for the percentage of CFLs in the baseline and to factor in a 90% realization rate. The recommended corrected UES contain these same factors and are therefore directly comparable to the Program UES.

Table 62: UES (without adjustment for building type) for PSE deemed commercial LED's (CONR and MCFL programs)

Measure	Program UES * (kWh/yr)	Review Adjustment UES * (kWh/yr)
MR 16	159	144
PAR 20	127	116
PAR 30	112	114
PAR 38/40 & Screw-in Recessed Can Retrofit Kits	122	142
Omni-directional	157	104
Decorative	96	86
Hard Wired Recessed Can Retrofit Kits	122	Not determined

* UES shown in table correspond to 4108 annual operating hours; they do not include adjustment for different operating hours due to building type.

The percentage of CFL's in the baseline is primarily based on the US DOE's 2010 U.S. Lighting Market Characterization; the wattage of the CFL lamps included in the baseline is the average per lamp type according to manufacturer catalogues.

The UES shown in the table above are based on 4108 annual operating hours which was derived from the Commercial Building Stock Assessment (CBSA), with building type hours weighted by regional square footage. At the end of 2012, PSE made a retroactive adjustment to the annual operating hours. The weighting was changed to reflect actual installations rather than square footage; these "by Building Type" operating hours are shown in Table 63.

Table 63: Annual Operating Hours by Building Type (from PSE SOS)

Building Type	Annual Operating Hours
Hotel Rooms	1643
School (k-12)	2704
Office	3068
Retail	3796
Warehouse	3952
Other	4368
Other Health	4576
Restaurant	4836
Grocery	5876
Hospital	6344
University	6396
Hotel Common Area	8320

SBDI is a direct install program, therefore baseline conditions and facility type are known for all installations and the program did not experience the deviation from the "typical" building distribution that occurred in the CONR & MCFL programs. Therefore, for SBDI, the PSE deemed UES do not include 2012 adjustments for percentage of CFLs in baseline or realization rate. Nor do they include the annual operating hours adjustment for building type (i.e. 4108 hrs. is used across the board).

The PSE deemed savings values (Program UES) are shown in Table 64 along with the recommended go-forward UES (Review Adjustment UES). The Review Adjustment UES are based on a lumen-equivalent baseline.

Table 64: UES for PSE deemed commercial LEDs (SBDI program)

Lamp Type	Program UES (kWh/year)	Review Adjustment UES (kWh/year)
MR 16	177	160
PAR 20	175	160
PAR 30	229	256
PAR 38 & 40	235	296
Omni-directional	291	193
Decorative	155	120

According to the PSE Source of Savings, baseline and measure lamp watts were derived from case studies of LED Magazines website www.ledsmagazine.com/casestudies and from Utility

projects from PSE, Snohomish County PUD, Seattle City Light and Tacoma Power. Table 65 shows the number of case studies used to support each savings value.

Table 65: Case studies supporting PSE deemed lamp wattages

Lamp Type	Number of case studies
PAR20	7
MR16	8
PAR 38 & 40	6
PAR30	10
A Lamp	4
Candelabra	2

The baseline wattages found by the PSE case studies differ significantly from baseline wattages based on equal light output. The industry standard method used to establish prescriptive screw-in lighting measures is to assume that the baseline and installed lighting have the same light output (i.e. they are "lumen equivalent"). Table 66 shows the difference between the original basis of savings and lumen equivalent watts.

Table 66: Lumen equivalent wattages

Lamp Type	PSE baseline watts	Lumen equivalent baseline watts
MR 16	50	11
PAR 20	50	11
PAR 30	78	16
PAR 38 & 40	90	18
Omnidirectional	58	11
Decorative	35	6

The CFL wattages would also be better derived as lumen equivalents, since lamps of a given type, especially the PAR38 & 40 and omnidirectional lamps, are available in a large range of wattages.

A case could be made that customers do not use lumen equivalence when installing LED's. This case would need to be based on a larger sample size than was used here to establish baseline wattage, and the sample would need to be selected with a random process.

The other assumptions that PSE used to derive savings, including hours of operation and CFL commercial saturation, are reasonable.

CFL Lighting: Small Business Direct Install (SBDI) program

The PSE deemed savings values (Program UES) are shown in Table 67. We did not attempt to calculate a recommended savings for this measure. We do not have enough information to derive savings values that match the original PSE savings bins. Our recommendation is to add savings bins to match lower lumen lamps.

Table 67: UES for PSE deemed commercial CFL's (SBDI program)

Measure	Program UES (kWh/yr)
Less than 26 Watts	155

Because this is a direct install program, these values do not include the June, 2012, updates (10% storage rate, decreasing the savings by 10%).

Linear Fluorescent Lighting

PSE established deemed values for commercial linear fluorescent lighting. Measures include direct-install T12 replacement, T8 upgrade, and de-lamping. The PSE deemed savings values are shown in Table 68.

Table 68: UES for PSE deemed linear fluorescent lighting

PSE Program	Measure	Program UES (kWh/yr)
SBDI	4' 1L T8 28W (LBF) 34	86
SBDI	4' 2L T8 28W (LBF)	115
SBDI	4' 2L T8 28W (LBF) (delamp & reflector) 34	411
SBDI	4' 2L T8 28W (LBF) (delamp) F96	292
SBDI	4' 2L T8 28W (LBF) 34	181
SBDI	4' 3L T8 28W (LBF) (delamp) 34	320
SBDI	4' 3L T8 28W (LBF) 34	201
SBDI	4' 4L T8 28W (LBF) 34	234
SBDI	4' 4L T8 28W (LBF) F96	148
SBDI	4' 4L T8 28W (NBF & reflector) F96	444
SBDI	4' 6L T8 (HBF)	1076
MCFL, CONR and SBL	Low wattage T8 relamp, 25 watts or less	26
MCFL, CONR and SBL	Low wattage T8 relamp, 26 to 28 watts	15
SBDI	New Fixture 2' 2L T8 17W (NBF) 120	370
SBDI	New Fixture 2' 2L T8 17W (NBF) 80	209
SBDI	New Fixture 3' 2L T8 25W (NBF) 160	477

Baseline and measure lamp watts were derived from standard sources. Hours of operation were derived from CBSA reported annual hours, weighted to an overall average value by regional building type square footage.

We verified that wattage values used for T12 and T8 lighting, as well as the ballast factors, are close to those used in the most recent version of the BPA lighting calculator (v3.1).

The derivation of annual hours is reasonable, but it would be improved by weighting by actual installations rather than by square footage.

Replacement of T12 fixtures needs consideration. The best researched local source, the BPA lighting calculator, no longer uses T12's as a baseline. Federal regulations have taken effect which prohibits the manufacture of inefficient T12's. Warehoused T12's can still be sold, and a large supply is available, but BPA found that sales of T12 have decreased to a small share of the market. BPA uses the market average T8 as the baseline for T12 replacement.

However, for a direct-install program, the case could be made that, in the absence of the program, small business customers would continue to purchase T12 lamps. Our judgment is that T12's continue to be an appropriate baseline for first-year direct-install savings. This should be revisited on an annual basis, and is unlikely to still be true after 2015.

In the absence of data on the number of installations by building type, which would enable calculation of operating hours, we are unable to create a table of recommended UES values.

Commercial Aerators

The commercial faucet aerator measure was reviewed by DNV GL, a member of our review team. SBW is a third-party implementer of aerators; therefore DNV GL performed this work to avoid a conflict of interest.

As part of the PSE Commercial Rebate program, PSE offers direct installation of faucet aerators. The PSE deemed savings values are shown in Table 69.

Table 69: UES for PSE deemed Commercial Faucet Aerator Measure

Measure	Program UES (kWh/yr)	Review Adjustment UES (kWh/yr)
Aerator Electric	2,423	760

The baseline faucet flow rate is the federal maximum 2.20 GPM[32] and the measure flow rate is the ultra-low flow 0.50 GPM[33] aerator. Savings are derived from the reduced hot water consumption that results from the reduction in full throttle faucet flow rate. The key UES savings assumptions are shown in Table 70.

[32] http://www1.eere.energy.gov/femp/program/waterefficiency_bmp7.html

[33] http://www.allianceforwaterefficiency.org/Faucet_Fixtures_Introduction.aspx

Table 70: Key Assumptions for Commercial Faucet Aerator Measure

Key assumptions	Value	Source
Existing Full Throttle Flow Rate	2.20 GPM	Energy Policy Act of 1992: Federal maximum faucet aerator flow rate
Replacement Full Throttle Flow Rate	0.50 GPM	ANSI standard ASME A112.18.1: Ultra low flow aerator flow rate
Number of fixtures	1	UES savings is per unit
Hours per Day Used	1 hr	Source not provided
Load Factor	0.60	Source not provided
Days per Year Used	365	Assumed to operate every day of the year
Water Supply Temperature	54 °F	Source not provided
Hot Water Temperature at Tank	130 °F	Source not provided
Point of Use Temperature	98 °F	Source not provided
Electric Water Heater Efficiency	0.99	Source not provided
Gas Water Heater Efficiency	0.60	Source not provided

The review team finds the UES savings calculation methodology to be reasonable, but recommends the inclusion of an additional "User setting flow rate" variable as well as updates to the faucet time of use, water temperature and heating efficiency assumption values.

According to the SBW Consulting, Inc. study, *ENERGY EFFICIENT SHOWERHEAD AND FAUCET AERATOR METERING STUDY MULTIFAMILY RESIDENCES: A MEASUREMENT AND EVALUATION REPORT* October 1994[34], full throttle flow rates are not a good representation of actual faucet usage for non-metering faucets. This study found that for bathroom and kitchen faucets, the ratio of user setting flow rate to full throttle flow rate is approximately 0.62. Therefore it is recommended that baseline and measure flow rates be multiplied by this ratio to produce user setting flow rates that are then used in place of the full throttle flow rate value when calculating UES savings.

The review team also recommends changing the Hours per Day Used from 1 hr/day to 8 hrs/day in order to represent a common work day, and changing the load factor value from 0.60 to 0.0625. This results in a total daily operation of 30 minutes (vs the current value of 36 minutes) which is the Federal Energy Management Program[35] estimation for faucet aerator. The review team also recommends modifying the Days per Year Used value to 360, to conservatively account for holiday closures.

Another recommendation is to update the three water temperature values to utilize the SBW metered water temperature data results of the PSE Direct Install program. These three

[34] http://www.bpa.gov/energy/n/reports/evaluation/residential/faucet_aerator.cfm

[35] http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calc.html

temperatures, presented in the list below, are similar to the existing measure temperature values, but eliminate uncertainty from the existing water temperature values.

- Mean supply water temperature of 61.8 °F
- Mean hot water temperature of 120.3 °F
- Mean point of use water temperature of 88.6 °F.

In regards to the electric water heater efficiencies, the review team recommends the adoption of water heater efficiency values found in the RTF Pre-Rinse Spray Valve[36] (PRSV) measure in lieu of water heating efficiency data from a PSE commercial saturation study. For electric water heating efficiency, the PRSV measure utilizes a 0.98 value, which comes from the DOE standards for electric water heating.

A summary of all the recommended measure alterations is presented below in Table 71.

Table 71: Recommended Alterations to Commercial Faucet Aerator Measure

Key assumptions	Value	Source
User Setting Flow Rate	= 0.62 x Full Throttle Flow Rate	*ENERGY EFFICIENT SHOWERHEAD AND FAUCET AERATOR METERING STUDY MULTIFAMILY RESIDENCES: A MEASUREMENT AND EVALUATION REPORT* October 1994
Hours per Day Used	8 hr	Engineering assumption: length of expected work day
Load Factor	0.0625	Federal Energy Management Program Estimation
Days per Year Used	360	Engineering assumption: conservatively accounts for holiday closures
Water Supply Temperature	61.8 °F	SBW metered data of PSE Direct Install program
Hot Water Temperature at Tank	120.3 °F	SBW metered data of PSE Direct Install program
Point of Use Temperature	88.6 °F	SBW metered data of PSE Direct Install program
Electric Water Heater Efficiency	0.98	RTF Pre-Rinse Spray Valve Measure
Gas Water Heater Efficiency	0.75	RTF Pre-Rinse Spray Valve Measure

[36] http://rtf.nwcouncil.org/measures/measure.asp?id=100

Surveys and on-site inspections

We inspected 78 Commercial Rebate sites encompassing fifteen sub-programs. Eleven of the site inspections were inspected by DNV GL in order to avoid conflict of interest with programs where SBW is the third-party installer (Pre-Rinse Spray Valves/Aerators DI and Cooler Miser DI sites). Across the 78 sites we visited, we did not find any significant issues. We did find several minor issues worth noting here for the purpose of providing feedback that may be useful to PSE in their future inspections:

- **Non-operational occupancy-based HVAC controls.** Our site inspection found one Commercial Rebate –Hospitality site where all 104 of the occupancy-based HVAC controls are installed but none of them are operational. The customer contact at this site reported that the occupancy sensors were never activated.
- **Uninstalled LEDs.** Our site inspection found one Commercial Rebate -Interior Lighting site with only 716 Integral Omnidirectional LEDs installed. The project files and PSE tracking database claim 800 as the measure quantity.
- **Uninstalled LED exit signs.** Our site inspection found one Commercial Rebate - Interior Lighting site with only two LED Exit Signs installed. The project file and PSE tracking database both list four as the measure quantity.
- **Uninstalled T8 lamps.** Our site inspection found one Commercial Rebate -Small Business Direct Install site with 61 2L-fixtures instead of 31 4L-fixtures as claimed in the tracking database. So all together there are two fewer lamps (T8 28W) installed than tracked in the database.
- **Uninstalled T8 lamps.** Our site inspection found one Commercial Rebate -Small Business Direct Install site with only six 3L-fixtures (T8 28W) instead of ten as claimed in the PSE tracking database.
- **Uninstalled CFLs and LEDs.** Our site inspection found one Commercial Rebate -Small Business Direct Install site with only approximately 75% of the 262 CFLs and LEDs installed. Customer interview confirmed that the direct install project has not been completed.
- **Re-wound motor no longer at facility.** Our site inspection found that re-wound motor was no longer at the facility. We determined that the motor had been on production equipment (compressor) that had since been sold.
- **Overridden occupancy-based HVAC controls.** Our site inspection found that in five rooms (out of 26 rooms that we inspected) the PTHP (portable terminal heat pump) power cords were plugged into the override socket after maid service. The maids are directed to plug the PTHP's into the controlled socket when they do their service.
- **Uninstalled LEDs.** Our inspection of a CFL Markdown (MCFL)site found only four LEDs installed and operating vs. 10 claimed. According to the business owner, one LED had recently been broken by vandals (the LEDs are located on the outside of a drive-up coffee stand). The V-team, during their initial inspection, found 5 LEDs installed which matches our inspection results (four installed + one recently broken) but does not match

the tracking database. The V-team marked this site as a "match" and noted that the other five LEDs had been "stolen/broken" during a break-in. There are only five sockets at the site, so it seems the V-team should have marked this site with a "finding."

- Follow-up from the PSE V-Team:

  History: The V-Team staff received this job through an upload from Commercial Program Team to verify 10 LED's. During the site visit, the V-Team staff found only 5 LED's were installed, the other 5 LED's were reported to be stolen from the business.

  V-Team Opportunities: The V-Team should have marked the job as "finding" because 10 LED's were not installed and there were only 5 sockets. PSE recommends additional training for V-team staff.

- **Uninstalled LEDs.** Our inspection of a MCFL site found only nine lamps installed and operating vs. 24 claimed; the remaining 15 lamps are waiting for the owner to install new fixtures which will accept the LED lamps. The V-team, during their initial inspection, had the same finding: only nine lamps installed. The V-team revisited the site three months later and recorded a "match" (i.e. all lamps installed).

  Follow-up from the PSE V-Team:

  History: The V-Team staff received this job through an upload from Commercial program to verify 24 LED's. The V-Team staff visited the site and updated Vdatabase with correct "finding" because only 9 LED's were installed. Later, a follow-up call was placed by the Commercial PSE Program Implementer to determine if the lamps had been installed and to inform this customer that the installation of all lamps must be completed to obtain the rebate (Commercial Team member Findings Reconciliation process includes either phone verification or visual verification. Onsite inspections are typically reserved for projects with a high count of uninstalled lamps or when the inspection revealed unusual results. In this case, a phone call seemed sufficient, given the distance and time required to count the project). During the phone call, the customer informed the Program Implementer of their intention to install the lamps in the coming days. The tone of the follow-up phone call led the Implementer to think that the project would be resolved by the customer, and as a result, the Program Implementer decided to take the customer's word for it and have the rebate paid as submitted with no findings.

  Commercial Program Process Opportunity: Commercial Team members should ensure that all lamps are installed before paying the rebate. In the event a customer states they will be installing the lamps, PSE will wait to pay the rebate until they confirm that the lamps are installed. If it seems that a visual verification is necessary, PSE will either conduct an onsite inspection or request digital images from the customer.

Impact evaluation

Note: The Impact Evaluation for E262-Commercial Rebate was part of a joint evaluation of E262 and E255-Small Business Lighting; therefore the discussion in this section is repeated (for the most part) under the Impact evaluation section for E255.

The evaluation report was not finalized in time so a draft hard copy was supplied by PSE for this review which focused solely on the impact evaluation of electrical savings. The evaluator sought to verify claimed savings and establish realization rates for the 2011-2012 evaluation period using engineering reviews of sampled project documents and on-site inspection as deemed necessary. Additionally, the evaluator reviewed documentation on all projects to examine how well PSE enters and tracks savings internally as well as PSE's business cases which establish prescriptive measure savings and custom savings calculation methods. The engineering review sample design used the stratified ratio estimation approach based on the assumption that the variance of each project's realization rate is generally much smaller than the variance of the magnitude of each project's savings. Coefficients of variation (CVs) assumed were in the range of 0.3 to 0.6, low end of the range for more certain non-control lighting measures and top end for less certain custom measures. The sample design targeted 10% precision at 90% confidence at the program level and 20% precision at 80% confidence at the measure stratum level. The former was achieved for both programs while the latter was achieved for all measure strata except "All Other" in Commercial Rebates which accounted for 18% of that program's savings. The project documentation review yielded realization rates of just over 100% for both programs indicating that PSE accurately tracks savings. The engineering review included on-site inspection for HVAC, motor and hot water uses. Furthermore, if other measures were present at sites with sampled measures, the additional measures were evaluated as well. The resulting realization rate was 91.6%. The deviation from 100% was due to a low realization rate on the Pre-Rinse Spray Valve measure stratum because of low in-service rates of faucet aerators as well as a downward adjustment to the prescriptive savings value.

Overall, the evaluation likely followed evaluation best practices but the report is scant on some critical details to confirm. Regarding the sample design, the evaluator states that CVs are based on previous evaluation experience. A stronger, more credible case could have been established if they had provided more specific information about the derivation of the assumed CVs. Furthermore, the evaluator could have reported the actual CVs of this evaluation to compare against the assumed CVs and for future reference. Concerning engineering review, the evaluator performed on-site inspection for measures representing less than half of Commercial Rebates total electric savings. In particular, there were no on-sites for lighting measures, regardless of whether controls were involved, including all of the sampled Small Business Lighting projects. The evaluator excused the latter away since PSE does its own verification, but without better explanation this seems to runs counter to best practices in impact evaluation. Moreover, beyond a general statement that they followed IPMVP protocol, the report provided insufficient information about specific practices they followed to re-estimate savings and review business cases for the various affected measures such as how baseline and current operating parameters were verified, when metering or trend data were used to inform inputs, or if a different savings algorithm was applied.

Status Update on ERR Action Items

Since an ERR was not ready in time for this review, we interviewed the program manager and evaluation team about the recommendations in the evaluation report that impact savings going forward.

- Occupancy Sensor reduction factors: the evaluator recommended changing from custom inputs to industry-accepted standards by space type
  - The program manager responded that they have made the suggested adjustment in the new 2014 Measure:Metrics business case
- Improve documentation practices: the evaluator suggested standardization of business case development and record keeping
  - The program manager responded that they have standardized the Measure:Metrics business case development process and increased the rigor of analysis, with an Energy Management Engineer QC review process now required to validate engineering assumptions and analysis approach. Additionally, all cited references are retained in M:M to ensure they are available for review at a later date. Furthermore, increased emphasis is being placed on capturing all secondary data sources (project files, etc.) and retaining them in the M:M repository
- In-service rate on commercial aerator savings: the evaluator recommended applying an in-service rate factor to the prescriptive savings for this measure
  - The program manager responded that they plan to apply the in-service rate factor in the 2014 program year once the factor has been finalized
- Update Premium HVAC business case: the evaluator found the current business case to be insufficiently traceable and suggested revising it
  - The program manager responded that the business case has been updated and will be applied to the 2014 program year

Review Conclusions

The evaluator mentioned several times throughout the report constraints on budget and time preventing a more thorough, rigorous evaluation. Examples of the impacts of the constraints include smaller sample sizes, less on-site inspection, and less metering. Due to the deficiencies cited regarding documentation and evaluation practices, we do not have high confidence in the realization rates. That said, the evaluation revealed several opportunities to improve savings estimations which PSE has already begun to implement. Going forward, PSE should continue to implement the evaluation recommendations and ensure that evaluations follow industry best practices supported by well-documented evaluation reporting.

Overall program

The PSE deemed UES values for LEDs and CFLs be adjusted on a go-forward basis.

3.3.13. E292 General Transmission and Distribution

This program implements energy conservation within PSE's own generation and distribution facilities. The BECAR methodology and findings are summarized in Table 72 and Table 73, respectively, followed by relevant details of the findings.

Table 72: E292 Program Review Methodology

Percentage of 2012-2013 portfolio savings (projected)	0.2%
BECAR level (low / medium / high)	Low
RTF deemed savings review	No
PSE deemed savings review	No
Surveys and on-site inspections	Pending
Impact evaluation	No
Direct assessment	No

Table 73: E292 Program Review Results

RTF deemed savings review	--
PSE deemed savings review	--
Surveys and on-site inspections	Completed review of 1 project; found no issues
Impact evaluation	--
Direct assessment	--
Overall program	

On-site inspections

We completed a desk review for one 2013 project; we found no issues.

Overall program

The review team found that PSE's 2012-13 savings claim for Low Income Weatherization is sound, defensible, and well-documented.

3.4. Cost-effectiveness

PSE made significant changes to their calculations and documentation between the 2010 and 2011 portfolio reporting periods. The changes carried over to the 2012-13 reporting period. The changes include:

- More transparent calculations and complete documentation.
- Instead of levelized avoided costs, using net present value of the stream of costs at year 1 (consistent with the Council required approach).
- Measure-level assignment of measure life and load shape instead of at the program level.

Making these changes is impressive, considering the PSE program tracking data are not in one system. Many of the cost-effectiveness calculations and steps are completed manually. These manual steps include setting up the program-level data. Measure life by measure are populated

by program teams manually and load shape by measure are assigned automatically. PSE had taken steps in the 2010-11 bi-annual reporting to continuously improve the tracking systems and cost-effectiveness analysis which has resulted in improvements to subsequent program and portfolio level reports.[37]

The data is aggregated on a program level with utility administrator costs and the weighted (by kWh) average measure life. The savings, measure costs and incentives were not reviewed for consistency across like measures or accuracy except for the proper summary at the portfolio level.[38] The rest of the calculation details are provided in the appendices of this report.

Calculating Cost-Effectiveness and Avoided Costs

Currently, PSE reports the PAC (or UC) and TRC test results. The methodologies used by PSE were found to be consistent with the guidelines established by NAPEE. The basic approach to calculating cost-effectiveness utilizes a net present value (NPV) approach. The cost-effectiveness 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 recommended calculation methodology. Details of the PSE calculations are provided by the PSE document, *Calculating the Cost-Effectiveness of Puget Sound Energy's Energy Efficiency Programs,* dated July 2011. All cost-effectiveness calculations are provided in a workbook (2012: "2012 CE FilingsREorganized_02.06.13_V3_NOLIWSHARHOLDER_DRAFT.xlsx" 2013: "Exhibit 2_2013 Cost Effectiveness_results ver1.00"). Each tab contains the data per program required to calculate the avoided costs (i.e. benefits) and costs at a measure level. The methodology and assumptions included in these documents and the appendix workbooks were used to review of the 2012 and 2013 program year cost-effectiveness analysis.

The previous 2010-11 BECAR reviewed the avoided costs and cost-effectiveness calculations in relation to the Council approach. The team reviewed PSE's approach for the 2011 integrated resource plan avoided cost, which is the source for the 2012 and 2013 calculations. The avoided costs and cost-effectiveness were found to be consistent with the Council's methodology. We did not conduct any additional review at this time, except to ensure that there were no changes to the Council's or PSE's approach.

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

The two entities, PSE and the Council, use different values for the inputs and assumptions to calculating cost-effectiveness but similar methodologies. In 2011, the Washington State

[37] This is explained also in the 2012 annual report and illustrated in the annual report Figure 4b.

[38] To properly review these values, the number of units installed per line item is necessary for normalizing and comparing. The column labeled 'units offered" is always a "1" and unit definition is not included. Both variables will greatly enhance the review of the calculations.

Conservation Work Group (WSCWG) looked at several parameters in this comparison (other utilities in Washington State were also reviewed). The findings of the comparison, also verified by the review team for the 2011 cost-effectiveness review) were summarized below in the previous biennial report, which included columns describing the PSE and Council method for calculating the TRC. These observations have not changed since 2011 cost-effectiveness calculations which were the reference year of the WSCWG work. The inputs and assumption to PSE calculations for 2012 and 2013 were from the 2011 Integrated Resource Planning (IRP) process (Docket UE-100961) which is used for the 2012-2013 portfolio. PSE primarily changed the value of avoided energy costs[39] and discount rates that were used for the 2012 and 2013 calculations based on the 2011 IRP.

Table 74: WSCWG TRC Methodology Comparison

Inputs	Consistency with Council Method
Avoided Energy & Capacity Benefits	
Direct avoided energy/capacity savings	PSE calculates separate avoided cost streams for energy and capacity and brings them together in its TRC calculation. The Council uses only avoided cost of energy.
Avoided T&D line losses	PSE utilizes average system losses by residential and non-residential end user; Council assumes marginal losses.
Deferred T&D system savings	PSE, like the Council, includes a T&D deferral credit which came out of the 6th plan.
Other	PSE also includes avoided cost of the renewable portfolio standard and planning adjustment.
Quantified Non-Energy Benefits	
Non-energy benefits (water, etc.)	PSE can include NEBs, consistent with the Council. Assumed values may vary.
Environmental externalities	All parties handle this similarly. Assumptions about values vary.
10% Power Act credit	PSE is consistent with the Council where it is applied to the avoided energy and capacity costs for the TRC calculation.
Un-quantified Non-Energy Benefits (if/how included)	PSE can use this to push its low-income program to achieve a TRC greater than 1.0, but it has not been necessary.
Costs	
Full incremental measure cost (material & labor)	All parties treat measure costs consistently. Assumptions about values may vary.
Ongoing and periodic O&M costs (plus or minus)	PSE includes O&M costs where data is available and where results would be materially affected. Assumed values may vary. Council extends the measure life with replacement costs to get to at least 20 years.
Non-incentive Program Costs (planning, marketing, delivery, admin, evaluation, etc.)	PSE includes non-incentive costs, consistent with the Council. Actual expenditures are used where the Council assumes 20% of capital costs for installing the measure.
Present Value Calculation Inputs	

[39] Review of the avoided costs from the IRP process is not included in this review. However, the extraction of the IRP process to use for cost-effectiveness calculations has been reviewed and documented in the document *Calculating the Cost-Effectiveness of Puget Sound Energy's Energy Efficiency Program*" and its appendices.

Inputs	Consistency with Council Method
Discount rate (real or nominal, pre-tax or post-tax, etc.)	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)	PSE uses one measure lifecycle as the time frame, whereas the Council uses a 20 year program analysis.

Avoided Energy Costs and Load Shapes

The embedded avoided energy costs and impact load shapes are different between PSE and the Council. The avoided energy costs differences were explained in more detail under the review of avoided energy costs in the previous BECAR. The team investigated the Council's embedded ProCost[40] macros to a limited degree in the previous review and since there were no calculations changes to the Council approach, this review was not done for the 2012 review. Generally, the algorithms have not changed with the Council's files that include the MC_AND_LOADSHAPE_6P.xls (last updated on August 15, 2013)[41] used in conjunction with the most recent template version of ProCost (RTFMeasureAssessmentTemplate_v1_1 (2013-06-04).xlsm). The plans for the ProCost Version 3.0 modifications are to include early retrofit measures (which are not yet part of the PSE analysis methodology), simultaneous retrofit and loss opportunity measures, marginal line losses that vary by time segment and load shape, 8760 hour load shapes, and calculation documentation. 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 has a different methodology in which they calculate a weighted average based on the hourly load shape profiles and costs to determine one annual avoided cost value.

Load shapes help select the avoided costs used in the cost-effectiveness analysis. PSE's calculation methodology is documented in *Calculating the Cost-Effectiveness of Puget Sound Energy's Energy Efficiency Programs* and its appendices. 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. This is exhibited by the fact that the calculated load factor[42] is not the same, yet both entities use the same calculation methodology (PSE values can be found in Appendix A3_WeightedAverageAnnualMarketPriceofElectricity.xls). The Council's load shapes are mostly from ELCAP (End-use Load and Consumer Assessment Program[43]). PSE is using load shapes developed by the Cadmus Group for PSE's conservation potential assessment used in the 2009 and 2011 IRP. These load shapes were developed through a combination of building simulation

[40] ProCost is the Council's cost-effectiveness calculator.

[41] New load shapes (for load factor and coincidence factor) were added for business-consumer electronics and network power management.

[42] 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). The same definition is used for PSE.

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

modeling and secondary sources, and were customized for PSE's territory. The load shapes used in PSE's 2012 cost-effectiveness model are a subset of those used in the IRP and did not change from the 2010-11 calculation methodology. 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 (as indicated in Table 75) participating in energy efficiency program to minimize the size and complexity of the cost-effectiveness model.

Table 75 compares the two load factor 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. The mapping and values did not change from the 2010-11 BECAR. PSE has more load shapes in their library than what is used in the analysis.

Table 75: 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*	

PSE C-E End Use	PSE	PSE Assumption	Council	Council End Use Description	Council Code
Commercial Refrigeration	0.6162	Grocery	0.52	Average of Commercial Grocery Refrigeration*	
Flat	NA	NA	1	Other - Flat Load Profile	FLAT

* From the "MC_AND_LOADSHAPE_6P.xls" tab called "Load & Coincident Factors". The average for lighting is across all End Use labeled "Commercial Lighting". For the refrigeration load factor, the average is across three measures identified as "Commercial Grocery Refrigeration."[44]

Cost Inputs

The Council defines three types 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

Incremental measure costs for PSE and the Council seem to be based on measure cost studies. 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* and PSE's explanation documented in *Calculating the Cost-Effectiveness of Puget Sound Energy's Energy Efficiency Programs.*" The team did not complete a detailed review of the measure costs, nor did the team review if the guidelines were followed within the program tracking system project documentation. More information about incremental measure costs used by PSE is provided later in this section.

The Council also includes ongoing costs and periodic operations and maintenance costs, if applicable. These costs are only captured in PSE's analysis for fuel switching measures as added cost of gas to the total utility cost.

PSE considers all utility incurred costs attributable to a program, except incentives, to be administrative costs.[45] This would include all marketing and evaluation costs, labor, materials,

[44] Please note that Commercial Grocery Night Covers, Commercial Grocery Refrigeration Load, and others are not included in the "Commercial Grocery Refrigeration" average.

office supplies, and outside services that it takes to run a given program. The actual percent administration cost allocations by program vary greatly. It is expected that costs vary by program type and delivery channels. The ProCost default is 20%.

Benefit Inputs

The only benefits tracked by PSE are energy savings, which are discussed in detail in the following avoided cost section.[46] However, it appears water savings are claimed for the showerhead, single family water heat, multi-family existing and new construction programs. These savings are not in similar measures for the non-residential sector. 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% conservation benefit. 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. Similar to NAPEE, the ProCost calculator defaults to one of the pre-determined values, depending on the defined sector/stakeholder (utilities and consumers), for the after- tax cost of capital. However, both the TRC and UC are only based on the utility perspective. The examination of RTF deemed measure workbooks show 5% as the real discount rate. PSE uses a nominal rate of 8.1% for all discounting and 2.5% for the inflation rate, consistent with the 2011 IRP.

Methodology Comparison

For the previous review of the 2010 program period, the team only did a cursory review of the ProCost calculations since there was no documentation. No new review was done for the 2012 and 2013 cost-effectiveness review. A new ProCost model with documentation was expected to be released in 2013. Based on a review of the RTF website, the following are itemized characteristics of the Council's approach, which the review team confirmed during the 2012 and 2013 review is not a part of PSE's existing methodology.

- 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)

[45] In 2013, LIW program costs moved the agency costs into measure costs, not program overhead. Regardless, the cost-effectiveness results are not affected by this change since it is considered a cost in either case.

[46] Other benefits may be included for the Low Income Weatherization program. Per the 2012 annual conservation report, PSE applies the price the customer pays for the installation of a CO detector, insulation, door sweeps, etc. as indicative of the value of the benefits that the customer receives.

For both the ProCost and the PSE calculators, only at the program level are administrative costs taken into consideration.

Some additional differences are that the Council splits up cost and other parameters by sponsor in its ProCost calculator, as shown in Table 76. PSE does not differentiate between different customer sectors.

Table 76: ProCost Sponsor Parameters

Sponsor Parameters	Customer	Wholesale Electric	Retail Electric	Natural Gas
Real After-Tax Cost of Capital	Varies*	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		

* 3.9% for residential, 6.7% for commercial and 7.6% for industrial

Calculating TRC Using the ProCost Model

The Order states that PSE's portfolio must pass the TRC test as defined by the Council. Previously, the review team attempted to apply certain PSE data points in ProCost at the program level to calculate the TRC to compare results. However, the variance in the avoided costs and discount rate between PSE and the Council surpass any variation we would see in using the ProCost methodology versus PSE. The avoided cost, discount rate and other inputs are the biggest variable, as opposed to methodology. Therefore, we concluded that PSE is in compliance with the Order. Based on previous analysis by the review team in 2010, using the ProCost model generally results in higher TRC and assumes that it will consistently result in higher TRC values, especially since the discount rate is lower. Since PSE may have different inputs such as the avoided cost values, the review team infers that while PSE's approach is conservative, it most likely does not limit its program design due to PSE's provision for including non-energy or un-quantified non-energy benefits in a program's TRC analysis[47]. However, it was

[47] A further investigation would need to be completed to see if PSE does not include certain measures/programs due to the TRC where it may pass using the Council's ProCost calculator.

not necessary to include non-energy benefits to justify programs because all 2012 and 2013 programs were already cost-effective, with TRCs above the necessary threshold.

3.4.2. 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

These are addressed below by input. The reporting for 2012 and 2013 followed the approach used in 2011, where reporting (or cost-effectiveness data analysis) was consistent across the programs, or at least summarized with consistent level of detailed measure-level data informed by information from individual projects.

Avoided Costs

The team reviewed the derivation of average annual avoided costs used in Exhibit 2 of the 2012 annual conservation report. These avoided costs values were used to calculate the benefits related to the energy savings. The levelized costs are provided in the tab "2012-2013 CE W T&D No ConsCredi" in the workbook 2012: "2012 CE FilingsREorganized_02.06.13_V3_NOLIWSHARHOLDER_DRAFT.xlsx" and 2013: "Exhibit 2_2013 Cost Effectiveness_results ver1.00". The derivation of the levelized costs is described in multiple steps in Appendix A of Calculating the Cost-Effectiveness of Puget Sound Energy's Energy Efficiency Programs.

The following 8,760 load shapes by end use by market sector were used to analyze avoided costs. Some load shapes relied on assumptions. For example, the commercial lighting average is based on office building even though the shape is applied to other building types, such as 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 enough to each other as to not affect the overall weighted average[48].

- SF Space Heat
- MF Space Heating
- Residential Water Heat

[48] The load shapes are from the 2009 IRP process. More load shapes are available but PSE use the most representative one as described in the previous section and summarized in Table 75.

- Residential Lighting
- Residential Heat Pump
- Residential Plug Load
- Commercial Cooking
- Commercial Cooling
- Commercial Heating
- Commercial Lighting
- Commercial Refrigeration
- Flat

To calculate the avoided energy and capacity costs, the review team validated the use of the following inputs and calculations[49]:

Avoided Energy Cost Inputs		Avoided Capacity Cost Inputs	
Commercial T&D Losses:	6.55%	Fixed Cost of Capacity ($/kw-yr):	$202.15
Residential T&D Losses:	8.02%	Deferred T&D Cost Credit ($/kw-yr):[2]	$54.32
Nominal Discount Rate:	8.1%	NW Power Act Regional Credit:[3]	10.0%
GDP Inflation:	2.5%	Nominal Discount Rate:	8.1%
Planning Adjustment:	$0.23/MWh	GDP Inflation:	2.5%
Renewable Portfolio Standard:	$11.49/MWh		
NW Power Act Regional Credit:	10.0%		

The final step required calculating the sum of avoided costs for energy and capacity, which are presented as the cumulative yearly NPV avoided-cost values for the cost-effectiveness calculations in Exhibit 2 of the 2012 and 2013 annual report. However, to add the two avoided-cost values, the capacity cost was converted to an energy cost in $/MWh using a peak factor. PSE calculated the peak factor, which can be found in Appendix A3_AvoidedCost Calculations_For the TRC.xls" on the "ResidentialLoadShapes" and "Commerical&IndustrialLoadShapes" tabs. Per Appendix A, it is calculated using the peak hour definition from the 2011 IRP as the percentage of total load during the peak hours over the

[49] Appendix A of *Calculating the Cost-Effectiveness of Puget Sound Energy's Energy Efficiency Programs.*

8760 period. This factor is applied to the capacity cost to convert it to the energy avoided costs[50].

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 savings goal, and since the region uses an average MW for program reporting (average value over the year, i.e., annual kWh savings divided by 8760), PSE instead uses the approach described in the final step (Appendices-Volume I). 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 the December peak hours may balance out across the program portfolio, it may overstate or understate the avoided cost for a particular end use.

Measure Life

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

For this review, the team verified the values entered at the measure level for the 2012 analysis of the cost-effectiveness calculations. The review was mostly to check for consistency and comparison to RTF sources. However, the team did not check for accuracy of measure life compared to third-party sources other than the RTF since the actual source of the values is unknown to the review team. However, the team did review for appropriateness. Other items to note are that the RTF is conducting a more thorough review of the measure lives. For example, the RTF adjusted the value for refrigerators to 17 years[51], as compared to the value PSE uses of 20 years or 22 years for new construction. For 2013, the values did not change. Therefore, a review of the annual process for updating parameter values should be considered.

PSE does conduct a review of the measure lives used for measures addressed by the RTF and update accordingly on an annual basis. If situations occur where values may be questioned or are different in two PSE sources, then an update may occur mid-program year.

The team reviewed if the proper measure life was used for the overall program to calculate cost-effectiveness (i.e. the weighted average value).

The team recognizes that Measure Metrics provides default measure-life values for deemed measures that should be used for all deemed measures and tracked by project to do this analysis. The previous BECAR encouraged 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 have such tables. PSE relies on the program teams to properly capture these values, for deemed and non-deemed values. The incentive and savings values are the critical, highly scrutinized values. In Measure Metrics, measure life and other variables are not universally reviewed with the same rigor.

[50] The 2011 IRP bases the peak value as the percentage of total load during the peak hours for a particular end use. The peak hour is the six hours ending at 7am to 12 pm and the six hours ending at 6pm to 11pm on weekdays in December. The load shapes obtained are labeled in 2005 dates so that calendar year is used to estimate the average load in peak hour.

[51] See the RTF document, "Measure Life Summary Sheet and Checklist 2012 0515.xlsx".

The following are findings from examining application of lives for the cost-effectiveness calculations:

- **Integral LED (CI Rebate and Small Business Lighting)**: For some measures the life is 3 and for others it is 5 years.
- **CI rebate (traffic signals)**: Great variation between red (4, 5, or 6 years), green (7, 16 years), yellow (16 years), and pedestrian (4 years).
- **Aerators (CI Rebate and residential)**: 5 years, but in the residential sector it is 10 years
- **LED exit signs (CI Rebate and Small Business Lighting)**: 10 years in CI rebate and 12 years in SBL. Measure Metrics states 12 years, but per discussions with PSE, this needs to be corrected to 10 years.
- **Insulation**: varies between wall, ceiling, window, and floor, as well as within the CI Retrofit and residential programs.
- **EULs**: In some cases an incorrect value was applied (most likely a data entry error):

  For 2012 Program Year

  - CI rebate (Electric units - Premium HVAC): 2 years
  - Open deep-fat fryers (CI rebate): 8 years, which is much lower than other cooking equipment; per discussions with PSE, cooking equipment is captured in Measure Metrics at 8 years.
  - Cooking equipment (CI rebate): 8-12 years; Measure Metrics state 8 years.
  - Air Source Heat Pump (SFNC): Used 12 years instead of 20.

  For 2013 Program Year

  - CI retrofit (Retrofit Windows): At both 15 and 30 years
  - CI retrofit (Retrofit Chillers): At both 18 and 20 years
  - Heat pump water heater (MFNC): Listed as 12 years and should be 15
  - Structure sealing (LIW): Listed as 20 and 25 years and not consistent with measure metrics.
  - CI High Voltage (VFD-Fans) listed as 10 years and in other places consistently at 15 years.

Measure Metrics does have a few inconsistencies in the value of measure life across similar measures in its own database and with the program teams' tracking systems. We recommend that PSE ensure Measure Metrics and program data are consistent and is up to date, since this value is critical in TRC calculations.

Load Shape

PSE calculated the avoided cost per kWh for each program using the load shape appropriate for the measure end-use type. The 2012 approach used by PSE is consistent with the Council's ProCost calculator by using a measure level assignment. Our observations are similar to those in

our 2011 review. One is that it is unclear if certain measures in business-sector programs are predominantly space heat or cooling end uses. Some load shapes were not referenced, such as commercial cooking and commercial refrigeration, and instead they used a flat end-use[52]. Additionally, the flat end-use is used both for business-sector and residential applications where other load shapes is not appropriate. The review team recommends adding more end use load shapes to PSE's library to allow for more disaggregation if it may significantly affect the end result (i.e. a large proportion of the savings from one market sector versus the one selected as the predominant end use load shape)[53] and use more appropriate load shapes that do exist in its library.

The review team believes there were errors in assigning load shapes to certain measures. These instances are listed below and are similar for 2012 and 2013:

- Refrigeration and Cooking (CI) measures should use commercial refrigeration or cooking load shape, respectively. In most cases, they use the Flat load shape.
- Exterior lighting uses Comm Lighting load shape since it is the most applicable; however, exterior lighting may merit its own load shape.
- Commissioning, Controls, Energy Management Systems (CI), and water heating (CI) line items should use the predominant end use affected by actual project and not Flat. In some cases, they use Comm Space Heat and it is unclear of space heat savings or cooling savings are more applicable, especially, if space heating uses gas.
- Single-family vs. Multi-family – for some line items, single-family space heat is used for multi-family, and vice versa.
- SF Space Heat is used for heat pump measures, where there is a residential heat pump load shape. (e.g. LIW ductless heat pump)

It is understood that load shapes are automatically assigned. The auto look-ups should be reviewed due to some mis-assignments. The overall effect of these mis-assignments is small relative to the volume that appears to be correct. We recommend that the evaluation team at PSE develop a protocol to review annually the tracking systems assignment of load shapes.

Incremental Measure Costs

The incremental measure costs (IMC) can be either the incremental cost or the full-measure cost. The appropriate value is dependent on the measure application, i.e., retrofit (RET), replace-on-burnout (ROB), or new construction (NEW). The 2008 Summit Blue Consulting report prepared for PSE, entitled *Best Practices for Assessing Measure Costs,* provides definitions of the proper cost basis for measures. This report is a good reference for best practices related to applying measure costs and should be used appropriately. Each program's tracking system should include a field for measure costs if deemed or actual value is used. The source of this value may vary by program delivery method, market sector, measure type, or

[52] The flat end use comes from the industrial load shape.

[53] See Table 75, "PSE assumption" column for sector selected.

other variables. For the most part, PSE's practices for applying measure costs have been consistent from 201 to 2013. The review team could not assess this parameter fully since the number of units per line item was not provided in the cost-effectiveness calculation to unitize the measures costs for comparison purposes across line items and across programs, similar to the measure life review.

The review team understands that the recommendations from the 2011 report have not been implemented. The following recommendations are from the 2010-11 review report and are still relevant. These recommendations include:

- Default to costs documented in the incremental cost study, as appropriate.
- Specify when to use incremental versus full cost.
- Collect costs for small commercial measures.
- Document a methodology for cost assumptions throughout the portfolio.
- Ensure documentation describes what may or may not be included as a measure 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.[54]

Per past review team experience, most programs that use deemed savings also use deemed incremental measure costs for both reporting and calculating cost-effectiveness. We recommend that PSE review the potential impacts of changing its practice of assessing measure costs per the above recommendations, such as incorporating contractor bonuses, or specifying 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. The source of cost, i.e. if deemed or not is used for cost-effectiveness calculations should be documented on a line item basis.

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. All program overhead costs are hard coded. The review team understands that an audit of PSE's accounting of administrator costs is normally conducted by another entity, and so we did not duplicate this effort. These costs represent a significant variable affecting total program cost-effectiveness.

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

Incentives and Energy Savings

The incentive value is considered only in the UC test. This review did not examine incentive and savings values. Savings were reviewed during the project-level portfolio review discussed in the preceding sections. It is assumed that the database tracking reports used for Exhibit 2 of the 2012 annual report captured the incentive payments correctly. All program incentive costs and savings are traceable back to a sum of individual measures for each project within the workbook.

3.4.3. Compliance

In summary, PSE conducts cost-effectiveness analyses on both the program and portfolio levels. PSE has met all of the Order requirements except as noted for calculating TRC, specifically being consistent with the Council's and NAPEE's methodology. PSE's 2012 and 2013 differences from the Council's methodology include:

a. Use of hourly annual avoided costs, instead of the Council's four segments of monthly by end use load shapes.

b. Inclusion of fewer load shapes than the Council's library (i.e., the Council has more disaggregated load shapes).

c. Council uses different discount rates depending on who is receiving the benefit and incurring the costs.

d. Exclusion of non-energy benefits.

e. Exclusion of O&M costs from measure cost.

4. CONCLUSIONS AND RECOMMENDATIONS

The BECAR effort has yielded a comprehensive assessment, as required by the Order, of PSE's electric efficiency portfolio claim for the 2012-13 biennium. This effort combined reviews of unit energy savings, project files, impact evaluations, and cost-effectiveness calculations, coupled with extensive on-site visits and interviews with PSE staff, to develop the following conclusions regarding the three study objectives. Conclusions and recommendations for each of the objective areas—portfolio savings, cost-effectiveness calculation, and future improvements in savings estimation—are provided below.

Portfolio Savings

Overall, the portfolio savings claim is well-documented and carefully verified. PSE is applying RTF and PSE unit energy savings values correctly and accurately, and the various inspection practices are sound, and appear to be ensuring project quality. Review team onsite inspections did not reveal any significant issues that warrant corrections to savings.

The review team did, however, uncover several UES values for which baseline conditions varied widely from industry practice or assumptions were out-of-date, leading us to recommend corrections to the portfolio claim. The overall impact of the agreed upon corrections reduce savings by 4,244 MWh (0.61% of the biennium claim) to a total of 696,636 MWh. This is above the biennium target of 666,000 MWh. Table E-1 summarizes BECAR savings findings by program.

Table 77 summarizes BECAR savings findings by program.

Cost-effectiveness Calculation

PSE has met all of the Order requirements and is generally in compliance with Council methodology, with only minor deviations regarding avoided costs, load shapes, and non-energy benefits and O&M costs.

Future Improvements in Savings Estimation

Below are suggestions, based on BECAR findings, for PSE to consider when making future program improvements.

Future Improvements in BECAR Process

A. ***Clarify scope and objectives for subsequent BECAR studies.*** The approach and emphasis of this BECAR differed substantially from the previous 2010-11 effort, and it is fair to expect that the scope and objectives for future BECARs will also evolve. That said, it is particularly important that the "rules of engagement" —most notably, the nature by which savings numbers are adjusted, and whether those adjustments apply retroactively or to future years—be established by all stakeholders clearly at the outset. With PSE and WUTC impetus, this BECAR underwent a shift in approach, well after the work plan had been approved and the effort begun, from a focus on validating actual portfolio savings to an investigation of what information was available to PSE at what time (going back to 2010

when the business cases for some measure savings were written) in order to determine if corrections to the savings claim were warranted based on PSE internal guidelines and guidelines developed specifically for this BECAR by PSE and the WUTC. This unexpected change complicated the 2012-13 BECAR process. At the conclusion of the review, all parties needed to negotiate what kinds of UES adjustments were appropriate to make retroactively. Adding clarity early on about these types of issues would certainly improve the BECAR process.

PSE Deemed Savings

A. ***Account for non-residential lighting mark-down installations.*** Develop defensible estimates of savings for CFL and LED lighting mark-downs installed in non-residential applications. Given that it appears a significant fraction (up to 20%) fall in the latter category, this may serve to increase program savings significantly.

B. ***Revise UES values highlighted in BECAR.*** The review team found several instances where PSE should examine and make appropriate adjustments to their bases for savings for the 2015 program year and beyond. These instances are summarized in Table 8 and described in further detail in the program-specific findings in Section 3.3 of the main report.

Impact evaluations

A. ***Reach agreement on study methodologies***. The review team found several instances where the PSE evaluation report responses (ERR) rejected the evaluation consultant's findings. To prevent program rejection of evaluation findings on methodological grounds, in the program planning phase of an evaluation there should be agreement on PSE impact evaluation methodology and techniques to be applied. Further, any methodology that is applied should be consistent with accepted evaluation practices. The final evaluation report should include a description and justification for the chosen methodology, including a discussion of the implications of using one methodology over another

B. ***Require consistent, high-quality evaluation reports.*** The review team observed the quality of evaluation reporting to be inconsistent, even when performed by the same evaluator. This included poor documentation of secondary information sources as well as evaluation activities. PSE can continue improving evaluation practices by requiring consistent, high quality documentation of evaluation activities to ensure confidence in evaluation results.

Cost-Effectiveness Calculations

A. ***Improve measure life consistency.*** Measure Metrics has a few inconsistencies in the value of measure life across similar measures in it and the program teams' tracking systems. Ensure measure lives in Measure Metrics and program tracking databases are consistent and up to date, since this value is critical in total resource cost (TRC) calculations. Consider using Measure Metrics like a resource manual for all measure parameters, including savings, measure life, measure cost, and load shape. Measure tracking systems should then refer to the central warehouse. Program measure

variables can then be clearly tracked, updated, and source documented at least on an annual basis.

B. ***Improve load shape assignment.*** While the overall effect is small, the load shapes for certain measures: Refrigeration and Cooking; Commissioning, Controls, Energy Management Systems (CI), and Single-family vs. Multi-family, as well as, SF Space Heat vs. SF Heat Pump for heat pump measures appear to have been mis-assigned. Develop a protocol, such as a Measure Metrics look up table, so that load shapes are assigned correctly.

C. ***Improve incremental measure life assignment.*** The process by which program teams assign incremental measure costs--a critical piece in the TRC calculation--is not clear. Document the process by which incremental measure costs are applied in program tracking databases and cost-effectiveness calculations.

Table 77: BECAR Portfolio Savings Summary

Tariff	Program / Element	% of claimed 2012-13 savings verified	2012 -2013 Claimed Savings (MWh)	2012-2013 BECAR Verified Savings (MWh)	Findings*
E201	Low Income Weatherization	100%	3,193	3,193	No issues uncovered.
E214a	SF existing - Residential Lighting	97.9%	190,238	186,181	Correction made to 2013 PSE deemed UES values for LED fixtures. Results of retailer survey show a significant portion of the program mark-down lamps (CFL and LED) are installed in non-residential facilities. This result could significantly increase program savings in 2014 and beyond. PSE deemed UES for residential and non-res CFLs and LEDs should be adjusted on a go-forward basis.
E214b	SF existing - Space Heat	98.8%	15,430	15,243	Correction made to 2013 PSE deemed UES values for heat pump measures.
E214c	SF existing - Water Heat	100%	1,454	1,454	No issues uncovered.
E214d	SF existing - HomePrint	100%	3,738	3,738	No issues uncovered.
E214e	SF existing - Appliances	100%	17,749	17,749	PSE deemed UES for refrigerator replacement should be adjusted on a go-forward basis.
E214f	SF existing - Showerheads	100%	10,356	10,356	No issues uncovered.
E214g	SF existing - Weatherization	100%	18,327	18,327	No issues uncovered.

Tariff	Program / Element	% of claimed 2012-13 savings verified	2012 -2013 Claimed Savings (MWh)	2012-2013 BECAR Verified Savings (MWh)	Findings*
E214h	Mobile home duct sealing	100%	-	-	No issues uncovered.
E214i	SF existing - Home Energy Reports	100%	12,267	12,267	No issues uncovered.
E215	SF New Construction	100%	3,953	3,953	No issues uncovered
E216	SF Fuel Conversion	100%	3,154	3,154	PSE deemed UES for space heat conversion measures should be adjusted on a go-forward basis.
E217	MF Existing	100%	44,209	44,209	No issues uncovered.
E218	MF New Construction	100%	2,198	2,198	No issues uncovered.
E250	C/I Retrofit	100%	145,432	145,432	No issues uncovered.
E251	C/I New Construction	100%	8,328	8,328	No issues uncovered.
E253	RCM Services	100%	32,907	32,907	No issues uncovered.
E255	Small Business Lighting Rebate	100%	29,523	29,523	PSE deemed UES for lighting measures should be adjusted on a go-forward basis.
E258	Large power user, self-directed	100%	36,313	36,313	No issues uncovered.
E262	Commercial Rebate	100%	81,982	81,982	PSE deemed UES for lighting measures should be adjusted on a go-forward basis.
E254	Northwest Energy Efficiency Alliance (NEEA)		38,800	n/a	Not included in BECAR scope.
E292	Generation, Transmission and Distribution	100%	1,327	1,327	No issues uncovered.
Total		99.4%	700,879	696,636	

* The term “significant issue” means an issue or finding that warrants further investigation, and the further investigation could lead to a recommendation to update a UES value or it could lead to a program realization rate less than 1.0.

sbw
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M e m o r a n d u m

FROM: Bing Tso

TO: Jim Perich-Anderson and Juliana Williams

DATE: May 8, 2014

RE: BECAR savings updates

This memo summarizes the savings corrections to PSE's reported 2012-13 biennial electric savings. The corrections affect 2013 savings for the following two PSE programs:

- **E214 – Single Family Existing Space Heat**: Corrected the UES values for the **Heat Pump Sizing & Lock out Controls** measure. The Review UES is taken directly from the RTF. The RTF savings value has been in effect since April 2012, and therefore the review team believes that PSE should have used the RTF savings value beginning in 2013.
- **E214 – Energy Efficient Lighting Services**: Corrected the UES values for the **Indoor LED Fixture** and **Outdoor LED Fixture** measures. The PSE deemed UES values are based on the assumptions of two lamps per fixture with a 10-watt replacement LED lamp. The review team used the same savings algorithm as PSE, but corrected the assumptions to one lamp per fixture with a 12-watt replacement LED lamp. These corrections are based on a review of PSE 2012 program retailer invoices, and therefore the corrections apply to the 2013 claim.

The following table summarizes the corrections, the claimed savings and the verified savings. The total 2012-2013 portfolio claimed savings is 700,879 MWh, and these corrections reduce this value by 4,243 MWh (0.61%).

Tariff	Program	Measure Name	2013 QTY	PSE Deemed UES (kWh/yr)	2013 Claimed Savings (kWh/yr)	Review UES (kWh/yr)	2013 Verified Savings (kWh/yr)	Delta Savings (kWh/yr)	Delta Savings (% of 2012-2013 Portfolio)	Explanation
E214	SF Existing Space Heat	Heat Pump Sizing & Lock out Controls	633	1,447	915,951	1,152	729,216	-186,735	-0.03%	Review UES is the current RTF UES, which has been in effect since April, 2012, and therefore the review team believes that PSE should have updated their deemed savings value to the RTF value at the beginning of 2013.
E214	Energy Efficient Lighting Services	Indoor LED Fixture	86,740	50	4,337,000	24	2,081,760	-2,255,240	-0.32%	PSE Deemed UES is based on 2 lamps per fixture and a 10W LED lamp. Review UES is based on a PSE 2012 program retailer invoices which show 1 lamp per fixture and a 12W LED lamp.
E214	Energy Efficient Lighting Services	Outdoor LED Fixture	21,194	143	3,030,742	58	1,229,252	-1,801,490	-0.26%	PSE Deemed UES is based on 2 lamps per fixture and a 10W LED lamp. Review UES is based on a PSE 2012 program retailer invoices which show 1 lamp per fixture and a 12W LED lamp.
								-4,243,465	**-0.61%**	**Total Impact**