Evaluation and Evaluation Report Response

Program:

- Schedule 250, Commercial and Industrial Retrofit

Program Year:

- 2018-2019

Contents:

- Evaluation Report
- PSE Evaluation Report Response

This document contains the final 2018-2019 Commercial and Industrial Retrofit Compliance Program Evaluation Report, prepared by Opinion Dynamics, PSE's independent evaluation contractor. In accordance with WUTC conditions, all PSE energy efficiency programs are evaluated by an independent, third party evaluator.[1] Evaluations are planned, conducted and reported in a transparent manner, affording opportunities for Commission and stakeholder review through the Conservation Resource Advisory Group (CRAG) and reported to the UTC.[2] Evaluations are conducted using best-practice approaches and techniques.[3]

PSE program managers and evaluation staff prepare an Evaluation Report Response (ERR) upon completion of an evaluation of their program. The ERR addresses and documents pertinent adjustments in program metrics or processes subsequent to the evaluation.

Please not that this is an evaluation of the program as it operated during the 2018-2019 program years.

This and all PSE evaluations are posted to *Conduit Northwest*. To view an electronic copy and to leave comments, visit https://conduitnw.org/Pages/File.aspx?rid=5053, or search words "PSE Commercial and Industrial Retrofit Program Evaluation Report."

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1. (6)(c.) Approved Strategies for Selecting and Evaluating Energy Conservation Savings, Proposed Conditions for the 2016-2017 PSE Electric Conservation.
2. PSE 2016-2017 Biennial Plan, Exhibit 8: Evaluation, Measurement & Verification (EM&V) Framework, Revised August 6, 2015
3. Ibid.

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2018-2019 Commercial and Industrial Retrofit Compliance Program Evaluation Report – FINAL

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1. Executive Summary

This report details evaluation results for Puget Sound Energy's (PSE's) Commercial and Industrial (C&I) Retrofit Program for the 2018-2019 biennium. The program offers incentives to C&I customers for making energy-efficient capital upgrades and adopting energy-efficient operation and maintenance (O&M) practices. Customers can access incentives through multiple subprograms covering a variety of energy-efficient upgrades, including (but not limited to) lighting, building shell, HVAC, industrial process, and O&M improvements. PSE administers the following subprograms under the broader C&I Retrofit program:

- The Industrial Systems Optimization Program (ISOP) helps industrial customers make operation and maintenance (O&M) energy improvements to their buildings. Notably, during this biennium, PSE piloted a new offering under ISOP called Strategic Energy Management (SEM).
- The Comprehensive Building Tune-up (CBTU) subprogram helps customers in large buildings make commissioning and O&M improvements and helps train building operations staff. Notably, during this biennium, CBTU staff began working with Seattle City Lights as a new program delivery partner.
- The Business Lighting subprogram helps customers access grants to install energy efficiency lighting and lighting controls.
- The Retrofit Grants subprogram helps customers access grants to install non-lighting equipment that typically involves HVAC controls, chiller upgrades, and boiler upgrades.
- The Advanced Rooftop Controls (ARC) subprogram helps customers install controls on packaged rooftop units.
- The Major HVAC Controls subprogram helps customers install HVAC control sequences.

PSE hired Opinion Dynamics Corporation to evaluate the program's performance throughout the biennium. The primary objective was to evaluate the electric and gas savings associated with the program. Additionally, we explored whether the Program Theory and Logic Models accurately reflected the current program design and documented any key program changes as well as the program's success and challenges from the perspective of key program management staff. We derived evaluation findings in this report from multiple evaluation activities including 25 in-depth interviews with key program management staff, a review of program materials and tracking data, a review of the program's theory and logic model, and an extensive engineering analysis of energy savings based on a desk review of 113 projects and site visits to 50 participating customers.

Program Design, Theory, and Logic

The C&I Retrofit Program has a number of activities designed to save customers energy across all of the sub-program opportunities, including grants and incentives, building assessments, trade ally coordination, marketing, and technical assistance. The design of these activities ultimately leads to energy savings amongst PSE's C&I customers as well as increase customer awareness of energy-efficient opportunities and customer satisfaction with PSE. Based on the evaluation team's review of the C&I Retrofit program theory and logic model (PTLM), we found it to be an accurate depiction of the overarching program's design and serves as a good overarching model for the program and subprograms. Further, the key performance metrics related to savings and participation are in alignment. As such, the evaluation team sees no need for updates

to the overall C&I Retrofit PTLM as a result of this evaluation. For reference purposes, a copy of the PTLM is found in Appendix B of this report.

The ISOP subprogram is the only subprogram with a dedicated PTLM. We also reviewed this PTLM for alignment with subprogram design. Overall, the processes described in the ISOP PTLM align with the program design. However, interviews with the ISOP program team revealed that some design changes do not reflect in the PTLM, and it requires an update. We specify the necessary modifications in the recommendations section of this Executive Summary.

Design and Implementation in this Biennium

Based on a series of interviews with program management staff, we explored the changes to subprograms in this biennium and the changes planned for the next biennium, in addition to the key successes and challenges that program staff experienced. We summarize these process-related findings in Table 1. PSE program staff identified several common opportunities for improvement across the C&I Retrofit subprograms. These opportunities included raising customer awareness of subprograms and program design changes, recruiting new customers to participate in subprogram offerings, and updating program designs to reflect changing market conditions. PSE program staff commonly streamlined application processes, coordinated program marketing materials and other components across programs wherever possible, and updated incentive structures to address these opportunities.

Table 1. Summary of Program Performance from Program Staff Perspective

Subprogram	Program Changes	Key Successes in Biennium	Key Challenges in Biennium
ISOP	▪ This biennium: Revised the incentive structure to reflect the amount of time it takes to complete the recommendations. ▪ Next biennium: Begin to operate the ISOP subprogram in-house, and as part of a suite of offerings for Industrial customers, SEM will transition to a separate program.	▪ Helping industrial customers identify opportunities to achieve savings without having to make significant capital investments. ▪ High customer satisfaction, subprogram provides a service that customers really want. ▪ Good source of cost-effective savings.	▪ Limited pool of industrial customers that are eligible. ▪ Long industrial project cycle poses challenges to closing out projects within 2-years. ▪ Customers generally do not have the capacity to complete all recommendations. ▪ Difficulty recruiting more industrial customers to the SEM portion.
CBTU	▪ This biennium: Began working with Seattle City Lights as a new partner in program delivery. ▪ Next biennium: Change the name to Existing Building Commissioning.	▪ Additional commissioning providers showed interest in participating. ▪ Some customers completed large projects that exceeded savings forecasts.	▪ The subprogram follows standardized processes, which poses challenges for serving a diverse set of customers with different needs.

Subprogram	Program Changes	Key Successes in Biennium	Key Challenges in Biennium
Business Lighting	▪ This biennium: Moved to a standardized incentive level per kWh, with a bonus incentive. The incentive for lighting controls increased. ▪ Next biennium: TLED installation incentives will decrease for partial retrofits. New fixture installation incentives will increase. Energy savings target will increase by 10%.	▪ PSE program staff made progress towards reducing project implementation timelines. ▪ The number of lighting controls installed through the subprogram increased.	▪ PSE reduced incentive levels for TLEDs and added bonus incentives for Luminaire Level Lighting Controls (LLCs) to instigate more comprehensive lighting upgrades, but this hasn't happened yet. ▪ Ensuring consistent understanding of eligible measures across all contractors and staff responsible for subprogram delivery.
Retrofit Grants	▪ This biennium: Aligned marketing materials and collateral across all C&I programs. Developed a prescriptive incentive for Variable Refrigerant Flow (VRF) projects. ▪ Next biennium: Expanding gas incentives to roof-top units. Increasing electric incentive levels. Developing targeted marketing for market actors.	▪ Program staff reported that the subprogram has been performing to expectations.	▪ Helping customers understand PSE's cost-effectiveness requirements. ▪ Construction in PSE's territory has slowed down leading to fewer channeling opportunities into the Retrofit Grants subprogram.
Advanced Rooftop Controls	▪ This biennium: Program staff added a simplified and less expensive version called ARC-Lite. Incentive design changed from custom to prescriptive. ▪ Next biennium: Explore an ARC offering for smaller commercial facilities. Change incentive from $ per ton to $ per unit.	▪ Improved working relationships with partner utilities which enabled program staff to be more responsive to solving issues. ▪ Built relationships with distributors and other market actors which helped to raise awareness.	▪ Low participation continued to be a challenge. Program staff reported that ARC generally underperformed against goals. Program staff actively worked to increase participation by expanding education to contractors and streamlining the application process.
Major HVAC Controls	▪ This biennium: Ex ante regression analyses updated to leverage normalized models with TMY3 Data. Began offering a performance incentive based on 10 months of post-install usage data. Incentive structures changed from custom to prescriptive and performance incentives. ▪ Next biennium: Offer a streamlined portion for smaller buildings.	▪ Standardization of the M&V process resulted in increased transparency and faster completion of internal M&V processes. ▪ Average site-level savings increased from approximately 15% to 25%. ▪ Customer recruitment efforts were successful, and participation increased.	▪ Building contractor awareness of M&V processes and incentive structure. ▪ Developing appropriate regression analyses to ensure savings are measured accurately.

Program Tracking Data

Our review of the program tracking databases revealed that PSE keeps thorough track of completed projects and collects the necessary project detail, such as customer information, project dates, detailed measure description, savings, and incentives. However, program tracking data lacked 2 key data fields:

- Incented measure quantity – the field was in the data but it was not populated with information. The lack of this information precludes the ability to track the quantity of measures installed against the quantity expected which is helpful in monitoring and assessing the program performance throughout a given program year.
- Subprogram type – the field was not in the data and the evaluation team, as a result, could not link all projects to specific subprograms. Without this link, the evaluation team could not design a sampling strategy for each sub-program for the engineering analyses. Having a dedicated field referencing the subprogram(s) associated with each project provides two key benefits: 1. This would better enable PSE program management staff to track and monitor subprogram performance against goals throughout a biennium and make decisions throughout implementation in response; and 2. This would enable the evaluation team to assess the savings performance of each subprogram against goals, understand the reasons why a subprogram over or underperformed against expectations, and recommend ways to garner more energy savings on a subprogram level.

Key Performance Indicators (KPIs) & Performance

Over the biennium, 1,199 customers[1] completed 1,326 projects resulting in 94,927 MWh electric savings and 732,709 therm savings. Energy savings and participation are the key indicators of program performance when compared to the program's goals for this biennium. Based on these indicators, the program performed as expected in terms of the gas goals and slightly underperformed on the electric side. Customer participation was below goal. Table 2 below summarizes program performance across the key metrics.

Table 2. C&I Retrofit Program Performance Across Key Performance Indicators

Metric	Definition	Success Criteria	Ex Ante	Ex Post	KPI Status
Electric savings	Amount of MWh savings for 2018-2019	118,500 MWh[a]	94,389 MWh	94,927 MWh	Ex ante savings were slightly below the 2018-2019 biennium goal, having reached 79.7% of the goal
Gas savings	Amount of therm savings for 2018-2019	825,000 therms[a]	826,936 therms	732,709 therms	Ex ante savings met 99.7% of 2018-2019 biennium goal
Customer participation	Number of customers taking part in the program	3,600 customer sites[b]	1,199	1,199	Customer participation met 33% of the goal

[a] Source: Exhibit 1. PSE Conservation Rider. Savings Goals and Budgets.

[b] Source: 2019 Annual Conservation Plan (page 83). file:///C:/Users/kavseikova/Downloads/ees_2019_annual_conservation_plan.pdf

[1] Defined by unique account numbers.

We evaluated the energy savings via site visits and engineering desk reviews. The realization rate between ex ante and ex post savings provides a sense of how accurate the ex ante savings were. A 100% realization rate indicates that we found no reason to change PSE's estimates of energy savings based on the engineering review. A rate less than 100% indicates we found discrepancies that led to lower savings than PSE's estimates, while a rate higher than 100% indicates we found discrepancies that led to larger savings than PSE's estimates.

Overall, the realization rate for the C&I Retrofit Program is 101% for the electric savings and 89% for the gas savings. The majority of the electric savings in the program came from lighting equipment, which accounted for 69% of ex ante electric savings. The majority of the gas savings came from a combination of equipment including compressed air, refrigeration, and water heating equipment, which accounted for 56% of ex ante gas savings.

On the electric side, we verified 100% of PSE's estimated savings for ISOP and CBTU and 99% of electric savings for estimated for motors. We found more savings than PSE estimated for lighting equipment (102% realization rate) but found slightly less savings than PSE's estimates for controls, HVAC, and other equipment types (realization rates of 96%, 96%, and 93%, respectively). Because lighting accounts for the vast majority of the electric savings, the final program-level realization rate for electric savings is weighted heavily toward that measure.

On the gas side, the realization rate was 92% for CBTU projects and 88% for other gas-saving measures. Due to relatively small contribution of the CBTU measures to the total savings, the final program-level realization rate for gas savings is weighted heavily toward the non-CBTU measures.

Table 3. Ex Post Gross Program Savings

Electric Fuel						
Program Component	End-use	Total Projects	Ex Ante kWh Savings	Ex-Post kWh Savings	Realization Rate	Relative Precision at 90% Confidence
Industrial System Optimization (ISOP)		9	4,377,103	4,377,103	100%	0.0%
Comprehensive Building Tune-Up (CBTU)		11	1,232,769	1,232,769	100%	0.0%
All Other	Lighting	1,068	65,521,172	66,971,261	102%	1.8%
	Controls	59	10,109,709	9,705,335	96%	3.0%
	Motors	58	5,653,677	5,584,208	99%	1.3%
	HVAC	40	2,840,790	2,719,984	96%	2.4%
	Other	44	4,653,864	4,336,553	93%	6.2%
Total – Electric		**1,289**	**94,389,083**	**94,927,214**	**101%**	**1.3%**

Electric Fuel Gas Fuel						
Program Component	**End-use**	**Total Projects**	**Ex Ante Therm Savings**	**Ex Post Therm Savings**	**Realization Rate**	**Relative Precision at 90% Confidence**
CBTU - Gas		3	40,311	37,123	92%	0.0%
All Other - Gas		102	786,625	695,586	88%	6.4%
Total – Gas		**105**	**826,936**	**732,709**	**89%**	**6.1 %**

Table 4 summarizes common issues found throughout the engineering analysis that drove the realization rates for each subprogram or equipment category. Again, we did not find any need to correct savings estimates for ISOP or CBTU electric savings, but we did make adjustments to other equipment categories that either slightly increased or decreased PSE's estimates of electric savings. Most of the issues driving the electric and gas realization rate are due to a combination of 4 issues that are commonly found in gross impact evaluations. The issues we found commonly related to 4 categories.

- **Quantity**: A difference in the number of measures installed and operating in the sample of projects led to an adjustment in quantity for the lighting, controls, motors, HVAC and other measure subprograms
- **Operating Conditions**: A difference in operating hours, temperature set-points, and/or control setting in the sample of projects led to an adjustment in operating conditions for lighting, motors, and gas subprograms.
- **Aligning with Latest RTF**: Applying the most recent assumptions from the RTF led to adjustments in the lighting, controls, HVAC, and other subprograms.
- **Database/Calculation Errors**: Database and calculation errors led to adjustments in lighting, controls, motors, controls and other subprograms. It is important to note that most of these discrepancies did not lead to major savings adjustments, as indicated by strong realization rates.

Notably, the first 2 categories related to quantity and operating conditions are very common adjustments in ex post impact evaluations and are somewhat out of PSE's control given that some equipment is removed for a variety of reasons and that operating conditions can change at any time for a given business. The next 2 categories are well within PSE's control and relate to aligning savings calculations with the latest RTF directives and controlling for database and calculation errors. While the impact of these 2 discrepancies on the realization rates was minor, PSE should continue efforts to ensure they always align with the RTF and are minimizing the database and calculation errors as much as possible.

Table 4. Common Discrepancies Found in Engineering Analysis[a]

	None	Quantity Adjustment	Operating Conditions Adjustment	Aligning with Latest RTF	Database / Calculation Error	Other Issues
ISOP	✓					
CBTU						✓
Lighting		✓	✓	✓	✓	
Controls		✓		✓	✓	

	None	Quantity Adjustment	Operating Conditions Adjustment	Aligning with Latest RTF	Database / Calculation Error	Other Issues
Motors		✓	✓		✓	
HVAC		✓		✓		
Other		✓		✓	✓	
Gas						✓

[a] Table identifies the issues that were found but does not reflect the magnitude of the impact on the realization rate.

Overall Conclusions & Recommendations

Given the strong realization rates for this program and the minimal number of issues found in the impact evaluation, PSE's approach to both calculating ex ante energy savings is sound, and PSE's internal verification does an exemplary job of mitigating risk, verifying installation and persistence, and keeping project documentation and savings updated.

Based on the evaluation findings, we make the following recommendations across 3 core domains:

Program Theory and Logic Model

We recommend that the following subprogram processes are updated in the ISOP PTLM:

- **Addition of SEM Offering**: A subset of industrial customers who have already participated in ISOP also participate in the Enhance It subprogram. Enhance It provides a behavior-based approach to energy efficiency that focuses on O&M improvements;
- **Removal of Sensei**: PSE did not offer the Sensei energy management software; and
- **Addition of Timeline for Project Completion**: The customer has 120 days to complete the project to receive the full incentive, customers that complete projects after 120 days are only eligible to receive 50% of the incentive.

Program Tracking Database Enhancements

- **Update program tracking data to include a subprogram identifier**: Having these data fields tracked on a routine basis will allow for greater analytical knowledge of program performance.

Savings Calculations

- Apply the savings from the RTF version available during PSE's deemed savings planning period (e.g., September prior). PSE applied savings to anti-sweat heater (ASH) controls from an older version of the Regional Technical Forum (RTF) (v.2.2 instead of v3.1).[2]
- Ensure all lighting projects use the lighting calculator with the most updated HVAC interaction factors.
- Monitor performance savings to ensure that baseline savings are removed to avoid double counting.

[2] Version 2.2 is dated January 2016.Version 3.1 is dated November 2016.

2. Introduction

This report details impact and process evaluation results for the Commercial and Industrial (C&I) Retrofit compliance program for the 2018-2019 biennium. Process evaluation results for the program were based primarily upon information gleaned from program staff interviews and a review of program tracking data and materials.

2.1 Program Description

The PSE C&I Retrofit program offers incentives to C&I customers for making energy-efficient capital upgrades and adopting energy-efficient operation and maintenance (O&M) practices. C&I customers can access incentives through various subprograms covering a variety of energy-efficient upgrades, including (but not limited to) lighting, building shell upgrades, HVAC upgrades, industrial process improvements, and O&M improvements. PSE administers the following subprograms under the broader C&I Retrofits compliance program:

- **Industrial Systems Optimization Program (ISOP).** This subprogram helps targeted industrial customers identify and implement projects that result in operational and management (O&M) energy improvements to their buildings. The ISOP program team highlights low-cost energy-saving options focused on energy-intensive systems, such as refrigeration, HVAC, compressed air, pumping, fans, and blowers.
- **Comprehensive Building Tune-up (CBTU).** The subprogram offers incentives for commissioning and operations and maintenance (O&M) improvements in existing buildings older than 18 months.
- **Business Lighting.** This subprogram offers customers grants for LEDs, linear lighting, and lighting controls projects. The design of this program provides a streamlined way for customers to access grants for custom lighting projects.
- **Retrofit Grants.** This subprogram is flexible by design and allows customers to apply for grants for projects that span any non-lighting measure or market segment. Typical measures include HVAC controls, chiller upgrades, and boiler upgrades. Program staff determine project incentives by considering project cost, projected savings, and cost-effectiveness standards. PSE offers $0.30 per kWh and $5 per therm of projected annual energy savings, up to 70% of the total cost of equipment and installation.
- **Advanced Rooftop Controls.** This subprogram encourages the installation of controls on existing single-zone packaged rooftop units (RTU) by offering fixed per ton incentives for electric and gas savings that cover up to 70% of the project cost. ARCs offer advanced features, including integrated air-side economizers, variable fan speeds, and demand-controlled ventilation.
- **Major HVAC Controls.** This subprogram provides grants to PSE C/I customers who add or update 3 or more substantial HVAC control sequences. Program participants are also eligible to receive additional HVAC upgrades including a web-based graphical user interface and HVAC controllers.

2.2 Summary of Program Achievements

Over the course of 2018 and 2019, a total of 1,326 projects were completed as part of the C&I Retrofit program resulting in 94,389,083 kWh electric savings and 826,936 gas savings. Notably, lighting projects accounted for a majority of electric savings (69%), while projects from the other end-use (e.g., compressed air, refrigeration, water heating, etc.) contributed to more than half of the C&I Retrofit program gas savings (56%).

Table 5. Summary of Program Achievements

Program Component	End-use	Total Projects	Ex Ante kWh Savings	% of Ex Ante kWh Savings	Ex Ante Therm Savings	% of Ex Ante Therm Savings
Industrial System Optimization (ISOP)		9	4,377,103	5%	0	0%
Comprehensive Building Tune-Up (CBTU)		11	1,232,769	1%	40,311	5%
All Other	Lighting	1,068	65,521,172	69%	0	0%
	Controls	69	10,109,709	11%	153,038	19%
	Motors	60	5,653,677	6%	3,953	0%
	HVAC	78	2,840,790	3%	169,983	21%
	Other	64	4,653,864	5%	459,651	56%
Total		**1,326[a]**	**94,389,083**	**100%**	**826,936**	**100%**

[a] Note that the total number of projects is lower than the sum of program component number of projects due to projects containing multiple end-uses.

3. Evaluation Methodology

This section summarizes the research objectives as well as the data sources and methodologies used to conduct this evaluation of the C&I Retrofit program.

3.1 Research Questions

The primary objective of the 2018-2019 evaluation of the C&I Retrofit program was to provide estimates of electric and gas savings associated with the program. This program has not been evaluated since 2015. Research questions varied by sub-program and are detailed in Table 6 below. All sub-programs underwent rigorous impact evaluation.

Table 6. Overview of C&I Retrofit Research Questions

Research Questions	Subprogram					
	ISOP	CBTU	Business Lighting	Retrofit Grants	Major HVAC Controls	ARC
Impact Questions						
What were the energy impacts of the program?	✓	✓	✓	✓	✓	✓
Process Questions						
How many projects were completed? By how many different customers? What types of projects?	✓	✓	✓	✓	✓	✓
Has the program's design and implementation changed since 2017? If so, how and why, and was this an advantageous change? Are key performance indicators aligned with the program design and implementation?	✓	✓	✓	✓	✓	✓
Did the program experience any implementation challenges in 2018/2019? If so, what were they, and how were they overcome?	✓	✓	✓	✓	✓	✓
What changes could the program make to its internal processes for issuing grants to streamline and shorten these processes?			✓			

3.2 Evaluation Activities

Based on the objectives outlined above, the evaluation team completed evaluation focused activities to characterize and understand the C&I Retrofit program performance. Table 7 summarizes the evaluation activities for each subprogram.

Table 7. Overview of C&I Retrofit Evaluation Approach

Subprogram	Program Staff In-Depth Interviews	Program Material Review	Program Theory and Logic Model Review	KPI Review	Engineering Analysis		
					Tracking Data Review	Engineering Desk Reviews	On-Site Measurement and Verification
ISOP	✓	✓	✓[a]	✓	✓	✓	✓
Comprehensive Building Tune-Up (CBTU)	✓	✓		✓	✓	✓	✓
Business Lighting Grants	✓	✓		✓	✓	✓	✓
Retrofit Grants	✓	✓		✓	✓		
Major HVAC Controls	✓	✓		✓	✓		
Advanced Rooftop Controls (ARC)	✓	✓		✓	✓		

[a] We received the PTLM for the overarching C&I retrofit program as well as the one specifically developed for the ISOP subprogram.

Below we describe each of the evaluation activities in greater detail.

Program Staff In-Depth Interviews

Opinion Dynamics completed a total of 25 interviews with program staff. The interviews covered a range of topics, including program implementation and design, recent and planned program changes, and program performance during the 2018-2019 biennium. We completed the interviews in 2 waves. We completed the first wave early in the biennium. We followed up with program staff in October and November of 2019 to obtain any updates on changes to program design or implementation and gain an understanding of programmatic successes and challenges.

Table 8. Summary of Program Staff In-Depth Interviews

Wave	Number of Interviews Completed
Wave 1 (May and June 2018)	14
Wave 2 (October through November 2019)	11

Program Material Review

The evaluation team has requested and reviewed PSE program materials, including program tracking data and program marketing materials. The evaluation team reviewed these materials to have a full understanding of the program design and implementation specifics, as well as from the perspective of program evaluability, ensuring that the evaluation tasks can move forward as planned.

Program Theory and Logic Model Review

The evaluation team reviewed the latest version of the program theory and logic model (PTLM) for the program. Additionally, we reviewed the program theory and logic model for the ISOP subprogram. This review included an assessment of whether all the standard PTLM components (i.e., inputs, activities, outputs, and outcomes) are present and whether the information in the PTLM reflects the program's design.

KPI Review

Using information from the program staff interviews on how PSE defines and measures success for its programs, the evaluation team compiled a list of existing and proposed KPIs. These KPIs generally fall into 3 categories:

- KPIs that PSE staff identified and currently track
- KPIs that PSE staff identified, but do not currently track
- KPIs not mentioned by PSE staff by proposed by the evaluation team

Notably, all programs consider energy savings, participation, and program spending to be KPIs. As such, the evaluation team reviewed these KPIs but focused on determining whether several additional KPIs could help program staff assess the performance of program operations, market penetration, or the achievement of broader company or policy goals.

Engineering Analysis

The impact analysis for the C&I Retrofit Program consisted of 2 core sets of activities:

- Tracking data review
- Engineering desk reviews with nested verification site visits

Tracking Data Review

The evaluation team reviewed program tracking data to verify data applicability, quality, accuracy, and completeness. This review also identified program measures, participation, missing data, duplicate records, installation dates, qualifying parameters that may disqualify measures (e.g., not achieving minimum efficiency requirements), and any other program-specific data needs. The team also assessed whether the tracking database maintains project-specific information for each parameter required to estimate measure and project level savings. As part of this review, we checked for consistency between savings documented in the program databases with the assumptions and algorithms documented in applicable program materials (e.g., Source of Savings) and other relevant resources (e.g., Regional Technical Forum).

The evaluation team performed a thorough review of the 2018-2019 program tracking database to verify tracking data applicability, quality, and completeness. The team also reviewed the algorithms and assumptions used for custom savings calculations and assess the reasonableness of custom savings estimates.

Engineering Desk Reviews with Nested Verification Site Visits

The evaluation team performed desk reviews for a representative sample of projects by examining all variable project documentation for sampled projects, including project applications, any supplied calculations, invoices, specification sheets, PSE verification forms and results, and any other project-specific data. The team used results from the desk reviews to:

- Prepare for onsite verification visits. The evaluation team completed desk reviews for projects where site visits were planned. Desk reviews provide an overview of each project identifying measure types, product specifications, and installed quantities, and all information used to prepare for site visits (e.g., estimate site visit duration, determine intra-site sampling strategies if applicable, plan for the types of data points to collect, etc.). The success of each site visit relies on findings and preparation from desk reviews, but note that evaluated savings depend on findings from site visits and not from desk reviews.
- Adjust energy savings. The team used findings from the desk reviews to not only verify the accuracy of the reported savings against data found in project documentation (e.g., invoiced quantities, measure specifications, etc.) but also to adjust energy savings calculations and use these savings when extrapolating to the population.

The evaluation team conducted site visits to gather project-specific information used to calculate custom savings for the sampled projects. During each site visit, the team conducted a walkthrough of the facility and recorded the information into a data input form. The team calculated evaluated savings using results from site visits which were later used to extrapolate to the population. Note that the team performed intra-site sampling for facilities where large quantities of measures were installed. These were rolled up to the facility level prior to extrapolating to the overall population.

Sampling Approach

The evaluation team conducted the desk reviews and site visits in 2 phases. The Phase 1 sample frame included desk reviews and site visits of projects completed from January 2018 through January 2019 and completed in early 2019. The Phase 1 impact evaluation for the C&I Retrofit Program included a combination of desk reviews and onsite verification visits. The evaluation team sampled projects by fuel (gas vs. electric) as well as by subprogram and end-use within the electric fuel domain. Notably, our initial planned approach to the sample design included stratifying projects by program subtype (ISOP, ARC, CBTU, etc.). Due to data limitations, however, we were unable to implement this approach for all subprograms and instead stratified projects sampled separately for the ISOP and CBTU subprograms, and stratified the remaining sample by key end-uses.

To inform the sample sizes for each subprogram and end-use, we relied on the following guiding principles:

- **Anticipated variation in realization rates.** We reserved additional sample for subprograms and end-uses with high anticipated variation in realization rates based on historical data and our expert judgement.
- **Available population of projects/size of subprogram and end-use.** We reserved additional sample for subprograms with large project population, in order to ensure better project coverage.

- **Contribution of subprogram to the overall compliance program savings.** We allocated larger sample sizes to subprograms and end-uses with significant contributions to the compliance program savings.
- **PSE recommended evaluation rigor.** Based on PSE guidance, we reserved additional sample for subprograms and end-uses not previously evaluated and therefore calling for a high level of evaluation rigor, such as CBTU subprogram.

The sampling strategies for Phase 1 projects included census efforts and stratified random sampling. The projects selected for onsite verification were a subset of projects selected for desk reviews (nested sample). The projects were randomly selected for onsite verification. We targeted a precision level of 10% at 90% confidence at the end-use level. Table 9 summarizes the Phase 1 sampling approach.

Table 9. Phase 1 Sampling Approach

Electric Fuel									
Program Component	End-use	Population		Sample Design	Desk Review Sample				Onsite Verification Sample
		Total Projects	Ex Ante kWh Savings		Total Projects	Ex Ante kWh Savings	% of Projects in Sample	% of Savings in Sample	
Industrial System Optimization (ISOP)		9	4,377,103	Census	9	4,377,103	100%	100%	0
Comprehensive Building Tune-Up (CBTU)		5	451,397	Census	2	451,397	100%	100%	2
All Other	Lighting	834	51,054,699	Stratified random sample	20	5,494,817	2%	11%	12
	Controls	46	7,000,654	Stratified random sample	10	4,646,917	22%	66%	7
	Motors	55	5,289,735	Stratified random sample	10	2,106,600	18%	40%	7
	HVAC	36	2,232,692	Stratified random sample	10	1,508,471	28%	68%	7
	Other	34	3,773,075	Stratified random sample	10	1,640,156	29%	43%	7
Total – Electric		**1,019**	**74,179,354**		**71**	**20,225,461**	**7%**	**27%**	**42**
Gas Fuel									
Program Component	End-use	Population		Sample Design	Desk Review Sample				Onsite Verification Sample
		Total Projects	Ex Ante Therm Savings		Total Projects	Ex Ante Therm Savings	% of Projects in Sample	% of Savings in Sample	
Total – Gas		**64**	**527,631**	**Stratified random sample**	**15**	**314,498**	**23%**	**60%**	**10**

The second phase of desk reviews was completed in late 2019 to capture any additional projects completed from February 2019 through June 2019. The second phase did not include the site visit component. Similar to Phase 1, we stratified electric projects by subprogram and end-use. Table 10 summarizes the Phase 2 sampling approach.

Table 10. Phase 2 Impact Sampling Approach

Electric Fuel								
Program Component	End-use	Population		Sample Design	Desk Review Sample			
		Total Projects	Ex Ante kWh Savings		Projects	Ex Ante Savings	% of Projects in Sample	% of Savings in Sample
Industrial System Optimization (ISOP)		0	0					
Comprehensive Building Tune-Up (CBTU)		2	313,799	Census attempt	2	313,799	100%	100%
All Other	Lighting	308	20,026,662	Stratified random sample	5	3,123,752	2%	16%
	Controls	12	2,990,422	Simple random sample	5	1,202,711	42%	40%
	Motors	4	105,746	Simple random sample	2	56,118	50%	53%
	HVAC	8	111,988	Simple random sample	3	36,841	38%	33%
	Other	10	783,045	Simple random sample	5	327,905	50%	42%
Total – Electric		**344**	**24,331,662**		**22**	**5,061,126**	**6%**	**21%**
Gas Fuel								
Program Component	End-use	Population		Sample Design	Desk Review Sample			
		Total Projects	Ex Ante Therm Savings		Projects	Ex Ante Therm Savings	% of Projects in Sample	% of Savings in Sample
Total – Gas		**23**	**166,008**	**Stratified random sample**	**5**	**41,423**	**22%**	**25%**

Detailed sampling approach methodology for each phase is provided in Appendix A. Table 11 summarizes completed site visits and desk reviews across the 2 phases. As can be seen in the table, Opinion Dynamics completed a total of 113 desk reviews and 50 site visits across program end-uses/components. Overall, completed desk reviews and site visits accounted for 27% of electric savings and 44% of gas savings.[3]

[3] Note that these percentages are based on the total ex ante energy savings achieved during the biennium, and not the ex ante savings achieved at the time the samples for each phase were drawn.

Table 11. Summary of Completed Desk Reviews and Site Visits

Program Component		Planned Desk Reviews	Completed Desk Reviews	Planned Site Visits	Completed Site Visits	% of Ex Ante Savings Captured in the Sample
Electric Fuel						
Industrial System Optimization (ISOP)		9	9			100%
Comprehensive Building Tune-Up (CBTU)		4	4	2	2	62%
All Other	Lighting	25	25	12	12	13%
	Controls	15	15	7	7	58%
	Motors	12	12	7	7	38%
	HVAC	13	13	7	7	54%
	Other	15	15	7	7	42%
Total – Electric		**93**	**93**	**42**	**42**	**27%**
Gas Fuel						
CBTU - Gas		1	1	1	1	23%
All Other - Gas		20	20	10	8	45%
Total - Gas		**21**	**21**	**11**	**9**	**44%**

Following the completion of engineering analysis, Opinion Dynamics calculated a project realization rate for each project, by taking the ratio of verified savings to the ex ante savings from the program tracking data.

Equation 1. Project Realization Rate

$$Project\ Realization\ Rate = \frac{Ex\ Post\ Energy\ Savings}{Ex\ Ante\ Energy\ Savings}$$

We used the stratified ratio estimator adjustment method[4] to extrapolate results for the sampled projects back to the overall population. Appendix A details the method.

[4] Levy, P.S. & S. Lemeshow. 2008. Sampling of Populations: Methods and Applications (4th Ed). Wiley: Hoboken, New Jersey.

4. Impact Evaluation Findings

This section contains detailed findings from the impact evaluation activities.

Through the review of the program tracking data, we found that the databases are clean and well-maintained. PSE keeps detailed track of participants and projects that they complete through the program, including information about businesses that complete program-supported projects, energy-efficient improvements that participants adopt through the program, dates, savings, and incentives. Our review, however, identified two key gaps in the program tracking data, namely measure quantity and subprogram information tracking.

- Incented measure quantity – the field was provided as part of the program tracking data but was blank. The lack of this information precluded the evaluation team of assessing program performance on a key metric.
- Subprogram type – the field was unavailable as part of the extract. The evaluation team, as a result, was unable to link in all cases individual projects to subprograms and draw a sub-program stratified sample of projects for engineering review. Having a dedicated field referencing the subprogram(s) that each project is associated with will allow to minimize uncertainties and allow for flexibility in evaluation approaches.

Table 12 summarizes gross realization rates by fuel and subprogram/end-use. As can be seen in the table, the program achieved 101% realization rate on the electric side and 89% realization rate on the gas side. On the electric side, the evaluation team verified 100% of savings for the ISOP and CBTU programs and 99% of electric savings for the motor end-use. Ex post savings for controls and HVAC end-uses were lower than ex ante due to the evaluation team's inability to verify measure installation, the use of outdated savings assumptions, and double counting of savings. A realization rate of 93% for the other electric end-use is primarily a function of measure removal. Phase 2 from the lighting measures were higher than ex ante, primarily due to an upward adjustment of the operating hours and interactive effect assumptions.

The key drivers of the 89% realization rate for gas fuel include high boiler savings for 1 of the sampled projects alongside baseline efficiency adjustment for 1 sampled project based on project documentation, and incorrect assumptions about refrigerated load cases.

Table 12. C&I Retrofit Compliance Program Impact Summary

Electric Fuel						
Program Component	End-use	Total Projects	Ex Ante kWh Savings	Ex-Post kWh Savings	Realization Rate	Relative Precision at 90% Confidence
Industrial System Optimization (ISOP)		9	4,377,103	4,377,103	100%	0.0%
Comprehensive Building Tune-Up (CBTU)		11	1,232,769	1,232,769	100%	0.0%
All Other	Lighting	1,068	65,521,172	66,971,261	102%	1.8%
	Controls	59	10,109,709	9,705,335	96%	3.0%
	Motors	58	5,653,677	5,584,208	99%	1.3%
	HVAC	40	2,840,790	2,719,984	96%	2.4%
	Other	44	4,653,864	4,336,553	93%	6.2%

Total – Electric		1,289	94,389,083	94,927,214	101%	1.3%
Gas Fuel						
Program Component	End-use	Total Projects	Ex Ante Therm Savings	Ex Post Therm Savings	Realization Rate	Relative Precision at 90% Confidence
CBTU - Gas		3	40,311	37,123	92%	0.0%
All Other - Gas		102	786,625	695,586	88%	6.4%
Total - Gas		**105**	**826,936**	**732,709**	**89%**	**6.1%**

In the sections below, we detail impact evaluation findings for each subprogram and end-use.

4.1 Industrial System Optimization

The evaluation team completed 9 desk reviews for the ISOP component of the C&I Retrofit Compliance Program. Table 13 summarizes the participant population of projects along with the planned and completed number of desk reviews.

Table 13. ISOP Desk Review Summary

Program Component	Total Projects	Planned Desk Reviews	Competed Desk Reviews
Industrial System Optimization (ISOP)	9	9	9

For each desk review, the evaluation team performed the following tasks:

- Checked the data for data entry errors, omissions, or inconsistencies by comparing project documentation to the program-tracking data extract.
- Identified project scope and confirmed that it aligns with the provided invoice and project documentation, where applicable.
- Reviewed PSE reported savings methodologies and calculations, including an assessment of the reasonableness of claimed savings as a percentage of annual baseline energy consumption given the facility type.
- Calculated evaluated gross energy savings based on the detailed information in the project files and compared those savings to the program-tracking data.

Seven of the 9 ISOP projects relied on whole-facility billing data analysis methods for determining reported performance savings. The remaining 2 projects leveraged equipment-level metering data for use in custom energy savings calculations because both facilities experienced occupancy and other operational changes that impacted whole-facility energy usage; therefore, it was no longer appropriate to use whole-facility billing data for savings calculation purposes. As part of our desk review efforts, we performed the following validation steps:

- Reviewed baseline regression model inputs for reasonableness given facility type for projects that relied on whole-facility billing data.

- Confirmed that project-specific baseline and performance periods are appropriately defined, such that they align with project completion dates.
- Examined Excel analysis files for formula and calculation errors for all projects regardless of savings methodology.

As a result of the review, we found that the majority (7 out of 9) of ISOP projects consisted of traditional retro-commissioning efforts, while 2 projects implemented Strategic Energy Management (SEM) actions. Our review did not identify any errors and verified the accurate performance for all of the savings calculations. Therefore, the program achieved an overall electric savings realization rate of 100%, as summarized in Table 14. Because our desk review was a census, as opposed to a sample, the concept of sampling precision does not apply.

Table 14. ISOP Gross Impact Results

Phase	Ex Ante Savings (kWh)	Realization Rate	Relative Precision at 90% Confidence	Ex Post Savings[a] (kWh)
Phase 1	4,377,103	100%	N/A	4,377,103
Phase 2	N/A	N/A	N/A	N/A
Total	**4,377,103**	**100%**	**N/A**	**4,377,103**

[a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

4.2 Comprehensive Building Tune-Up (CBTU)

Our gross impact evaluation for CBTU subprogram included desk reviews and onsite verification visits for a census of projects completed from January 2018 through July 2019. Table 15 summarizes the participant population of projects along with the planned and completed number of desk reviews and onsite visits.

Table 15. CBTU Desk Review and Site Visit Summary

Phase	Number of Projects				
	Population	Planned Desk Reviews	Competed Desk Reviews	Planned Site Visits	Completed Site Visits
Phase 1	5[a]	5	5	2	2
Phase 2	2	2	2		

[a] 3 CBTU phase I projects did not claim savings, and the evaluators reviewed these projects to identify if any energy savings could have been claimed but did not find any.

The CBTU program provides grants in 2 phases. The phase 1 grant is paid if the project proceeds with the recommended building and energy management system upgrades. The phase 1 ex ante savings are usually claimed as 7% of metered energy consumption during the baseline period of the previous year. The phase 2 grant is paid if the annual weather normalized metered energy consumption analysis shows at least 8% in whole-facility energy use reduction 1 year after the tune-up.

As part of the desk reviews, we completed the following:

- Reviewed all project documentation, including PSE worksheets, implementation inspection photos, invoices, and savings calculations.

- Ensured contents of PSE's worksheets are consistent with product specifications and invoices; and
- Checked the data for data entry errors, omissions, outliers, and inconsistencies by comparing project documentation to the program tracking data.

As part of the onsite verification visits, we completed the following:

- Verified installed measure quantities.
- Verified HVAC control strategies installed and recorded their current operating ranges.

Based on the sample of 4 desk reviews and 2 onsite verification visits, we did not find strong reasons to adjust the evaluated CBTU project electricity savings. For 1 of the 2 CBTU projects with gas savings, we adjusted the baseline consumption to align with all available project documentation resulting in an 89% realization rate for this project. Table 16 and [a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

Table 17 summarize the reported and evaluated electric energy and therm savings for the CBTU measures, along with the realization rate and associated relative precision at 90% confidence.

Table 16. CBTU - Electric Gross Impact Results

Phase	Ex Ante Savings (kWh)	Realization Rate	Relative Precision at 90% Confidence	Ex Post Savings[a] (kWh)
Phase 1	451,397	100%	N/A	451,397
Phase 2	313,799	100%	N/A	313,799
Total	**765,196**	**100%**	**N/A**	**765,196**

[a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

Table 17. CBTU – Gas Gross Impact Results

Phase	Ex Ante Savings (Therms)	Realization Rate	Relative Precision at 90% Confidence	Ex Post Savings[a] (Therms)
Phase 1	2,244	100%	N/A	2,244
Phase 2	7,082	89%	N/A	6,323
Total	**9,326**	**92%**	**N/A**	**8,567**

[a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

4.3 All Other Electric

4.3.1 Lighting End-use

Our gross impact evaluation for the lighting component of the C&I Retrofit Compliance program included desk reviews and onsite verification visits for a sample of lighting projects. Table 18 summarizes the participant population of projects along with the planned and completed number of desk reviews and onsite visits.

Table 18. Lighting End-use Desk Review and Site Visit Summary

Phase	Number of Projects				
	Population	Planned Desk Reviews	Competed Desk Reviews	Planned Site Visits	Completed Site Visits
Phase 1	834	20	20	12	12
Phase 2	308	5	5		

As part of the desk reviews, we completed the following:

- Reviewed all project documentation, including PSE Business Lighting worksheets, implementation inspection photos, invoices, and savings calculations.
- Ensured all lamp/fixture models and wattages entered into PSE's Business Lighting worksheets are consistent with product specifications and invoices.
- Checked the data for data entry errors, omissions, outliers, and inconsistencies by comparing project documentation to the program tracking data.

As part of the onsite verification visits, we completed the following:

- Verified installed measure quantities.
- Recorded operational hours and measure control types (occupancy sensors, timer, photocell, on-off switch, etc.).
- Gathered additional facility information that impact savings estimates (i.e., facility shift schedules, change in occupancy).

Based on the results from the desk reviews and onsite visits, we calculated evaluated savings using verified measure quantities, updated operating hours, and other assumptions based on the Regional Technical Forum (RTF).

Based on the sample of 25 desk reviews and 12 onsite verification visits, we found the following:

- **Few differences in operating hours:** We verified operating hours in the program tracking data for each lighting type through interviewing onsite personnel and applied them when calculating ex post savings. Across all 12 projects receiving an onsite visit, operating hours recorded by the evaluation team while onsite were approximately 5% higher than tracked operating hours. Most of this difference is driven by 1 project, representing 36% of sampled lighting savings, with operating hours that increased by 39%.
- **Nearly all tracked measures are installed and operating:** Through the onsite verification visits, we confirmed that nearly all (99.7%) of lighting measures were in place and operating.
- **Small differences in HVAC interaction factors:** HVAC interaction factors used to calculate reported savings diverge from the factors prescribed in the RTF, albeit only marginally. Upon further exploration, we confirmed that savings for nearly half of the calculations for the sampled lighting projects (11 out of 25) used outdated interactive effects from the earlier version of the RTF. This resulted in a 4% increase of savings for the affected projects.
- **Rounding error:** PSE savings calculation workbooks round values to 3 decimal places during an intermediate step of calculating power (kW) savings from the existing and proposed lighting types.

This results in a compounded rounding error in the usage of power savings to calculate measure-level energy (kWh) savings. We did not round in any intermediate steps when calculating ex post kWh savings. This resulted in a small (0.3%) upward change in savings.

Table 19 summarizes the reported and evaluated electric energy savings for the lighting measures, along with the realization rate and associated relative precision at 90% confidence.

Table 19. Lighting End-use Gross Impact Results

Phase	Ex Ante Savings (kWh)	Realization Rate	Relative Precision at 90% Confidence	Ex Post Savings[a] (kWh)
Phase 1	50,828,583	103%	2.3%	52,283,087
Phase 2	14,692,589	100%	0.1%	14,678,415
Total	**65,521,172**	**102%**	**1.8%**	**66,961,502**

[a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

4.3.2 Controls End-use

Our gross impact evaluation for the controls component of the C&I Retrofit Compliance program included desk reviews and onsite verification visits for a sample of controls projects. Table 20 summarizes the participant population of projects along with the planned and completed number of desk reviews and onsite visits.

Table 20. Controls End-use Desk Review and Site Visit Summary

Phase	Number of Projects				
	Population	Planned Desk Reviews	Competed Desk Reviews	Planned Site Visits	Completed Site Visits
Phase 1	46	10	10	7	7
Phase 2	12	5	5		

As part of the desk reviews, we completed the following:

- Reviewed all project documentation, including PSE Controls Incentive Calculator worksheets, billing data (when available), implementation inspection photos, invoices, and savings calculations.
- Ensured contents of PSE's control worksheets are consistent with product specifications (when applicable) and invoices.
- Reviewed baseline and post billing data periods to ensure they are within the correct timeframe of the project (i.e., confirmed baseline period was before the install of measures).
- Checked the data for data entry errors, omissions, outliers, and inconsistencies by comparing project documentation to the program tracking data.

As part of the onsite verification visits, we completed the following:

- Discussed control measures with building operators
- Reviewed trend data, when available
- Ensured site conditions align with those specified in PSE's worksheets

- Verified installed measure quantities for quantifiable measures (e.g., anti-sweat heater (ASH) controllers)
- Confirmed Energy Management System (EMS) control settings remain unchanged
- Recorded operational hours and ASH control temperatures

Based on the results of the desk reviews and onsite visits, we calculated ex post savings using verified measure quantities, updated measure information, and other assumptions based on the PSE Controls Incentive Calculator, the RTF, and other regularly utilized savings estimation equations.

Based on the sample of 15 desk reviews and 7 onsite verification visits, we found the following:

- **Fewer EMS controls implemented:** The evaluation team confirmed that 3 Energy Management System (EMS) control settings[5] out of 62 (4.8%) were no longer enabled for 1 project. The impact to overall realization rates is small, decreasing savings by 4% for 1 project that accounted for 7% of the sampled savings.
- **RTF savings revised after initial estimates:** 2 projects relied on deemed savings from the RTF for ASH controls. PSE applied these savings from an older version of the RTF (v.2.2 instead of v3.1)[6]. These 2 projects accounted for 4% of total controls savings. On average, this reduced savings by 16% for affected projects.
- **Double counted savings for 1 project.** For 1 project, performance savings were inclusive of the baseline savings, thus double counting a portion of the savings, and as a result overestimating savings by 19%. The project accounted for 3% of the sampled savings.

Table 21 summarizes the reported and evaluated electric energy savings for the controls measures, along with the realization rate and associated relative precision at 90% confidence.

Table 21. Controls End-use Gross Impact Results

Phase	Ex Ante Savings (kWh)	Realization Rate	Relative Precision at 90% Confidence	Ex Post Savings[a] (kWh)
Phase 1	7,000,654	94%	4.3%	6,610,849
Phase 2	2,990,422	99%	0.8%	2,975,022
Total	**9,991,076**	**96%**	**3.0%**	**9,585,871**

[a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

[5] Three control settings for 1 property were no longer implemented.
[6] Version 2.2 is dated January 2016.Version 3.1 is dated November 2016

4.3.3 Motors End-use

Our gross impact evaluation for the motors component of the C&I Retrofit Compliance program included desk reviews and onsite verification visits for a sample of projects. Table 22 summarizes the participant population of projects along with the planned and completed number of desk reviews and onsite visits.

Table 22. Motors End-use Desk Review and Site Visit Summary

Phase	Number of Projects				
	Population (as of January 2019)	Planned Desk Reviews	Competed Desk Reviews	Planned Site Visits	Completed Site Visits
Phase 1	55	10	10	7	7
Phase 2	4	2	2		

As part of the desk reviews, we completed the following:

- Reviewed all project documentation, including PSE motor worksheets, implementation inspection photos, invoices, and savings calculations.
- Ensured contents of PSE's worksheets are consistent with product specifications and invoices.
- Checked the data for data entry errors, omissions, outliers, and inconsistencies by comparing project documentation to the program tracking data.

As part of the onsite verification visits, we completed the following:

- Verified installed measure quantities including Variable Frequency Drives (VFDs), motor replacements (e.g., electronically commutated motors (ECMs)), and controls.
- Recorded motor horsepower and checked against project documentation to verify accuracy.
- Recorded estimated operational hours and fan runtime hours.

Based on the results of the desk reviews and onsite visits, we calculated evaluated savings using verified measure quantities, updated measure information, and other assumptions based on PSE's calculators, the RTF, and other regularly utilized savings estimation equations.

Based on the sample of 12 desk reviews and 7 onsite verification visits, we found the following:

- **Fewer ECMs than expected:** We were unable to verify 8 out of 400 (2%) reach-in or walk-in cooler motor replacements. We learned during onsite verification visits of the removal of some reach-ins from the store. From speaking with store managers, some removals were part of changes in layout to the stores. We verified the presence and operation of all other measures.
- **Unable to assess installation of 1 VFD and runtime hours for 2 VFDs:** We could not locate 1 of 5 installed VFDs at 1 of the sites due to building staff's unfamiliarity with the project. Additionally, we were unable to verify runtime hours for 2 VFDs for the same reason. Facility staff were unfamiliar with their operation, and there was no trend data available. Given we were unable to gather information while onsite to fairly assess the project, we instead relied on the information provided in PSE's project documentation for this particular site. As there were no discrepancies with other installed measures, we made no adjustments to savings.

- **Decrease in fan runtime hours:** We confirmed with building staff for 1 site that the runtime hours for VFDs provided in project documentation was approximately 8% higher than the actual operation. We used PSE's savings calculators to adjust savings by replacing the runtime hours with those gathered onsite.
- **Small error in PSE calculation workbook:** We identified a minor error in 1 of PSE's calculators for 1 project where it mistakenly omits 8 hours of fan operation. The impact on savings due to this error was negligible.

Table 23 summarizes the reported and evaluated electric energy savings for the motors measures, along with the realization rate and associated relative precision at 90% confidence.

Table 23. Motors End-use Gross Impact Results

Phase	Ex Ante Savings (kWh)	Realization Rate	Relative Precision at 90% Confidence	Ex Post Savings[a] (kWh)
Phase 1	5,289,735	99%	1.4%	5,223,422
Phase 2	105,746	100%	0.0%	105,746
Total	**5,395,481**	**99%**	**1.3%**	**5,329,168**

[a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

4.3.4 HVAC End-use

The gross impact evaluation for the HVAC end-use included desk reviews and onsite verification visits for a sample of HVAC projects. Table 24 summarizes the participant population of projects along with the planned and completed number of desk reviews and onsite visits.

Table 24. HVAC End-use Desk Review and Site Visit Summary

Phase	Number of Projects				
	Population	Planned Desk Reviews	Competed Desk Reviews	Planned Site Visits	Completed Site Visits
Phase 1	36	10	10	7	7
Phase 2	8	3	3		

As part of the desk reviews, we completed the following:

- Reviewed all project documentation including PSE HVAC worksheets, implementation inspection photos, invoices, and savings calculations;
- Ensured contents of PSE's HVAC worksheets are consistent with product specifications and invoices; and
- Checked the data for data entry errors, omissions, outliers, and inconsistencies by comparing project documentation to the program tracking data.

As part of the onsite verification visits, we completed the following:

- Verified installed measure quantities
- Recorded equipment type, operational hours, temperature and control settings

Based on the results of the desk reviews and onsite visits, we calculated evaluated savings using verified measure quantities, updated measure information, and other assumptions based on the Regional Technical Forum (RTF).

Based on the sample of 13 desk reviews and 7 onsite verification visits, we found the following:

- **Fewer ASH controls installed:** We were unable to verify 2 out of 996 (0.2%) anti-sweat heater (ASH) controls. We learned during onsite verification visits that reach-ins were removed and relocated after the implemented measurement. We verified the presence and operation of all other measures.
- **RTF savings revised after initial estimates:** 6 projects relied on deemed savings from the RTF for ASH controls. PSE applied these savings from an older version of the RTF (v.2.2 instead of v3.1)[7]. These 6 projects accounted for 47% of total HVAC sample savings. On average, this error reduced savings by 16% for the affected projects.

Table 25 summarizes the reported and evaluated electric energy savings for the HVAC measures, along with the realization rate and associated relative precision at 90% confidence.

Table 25. HVAC End-use Gross Impact Results

Phase	Ex Ante Savings (kWh)	Realization Rate	Relative Precision at 90% Confidence	Ex Post Savings[a] (kWh)
Phase 1	2,232,692	96%	2.6%	2,132,760
Phase 2	111,988	100%	0.0%	111,988
Total	**2,344,680**	**96%**	**2.4%**	**2,244,748**

[a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

4.3.5 Other End-uses

Our gross impact evaluation for the other end-use component of the C&I Retrofit Compliance program included desk reviews and onsite verification visits for a sample of projects. Table 26 summarizes the participant population of projects along with the planned and completed number of desk reviews and onsite visits.

Table 26. Other End-use Desk Review and Site Visit Summary

Phase	Number of Projects				
	Population	Planned Desk Reviews	Competed Desk Reviews	Planned Site Visits	Completed Site Visits
Phase 1	46	10	10	7	7
Phase 2	10	5	5		

As part of the desk reviews, we completed the following:

- Reviewed all project documentation including PSE worksheets, implementation inspection photos, invoices, and savings calculations
- Ensured contents of PSE's worksheets are consistent with product specifications and invoices

[7] Version 2.2 is dated January 2016.Version 3.1 is dated November 2016.

- Checked the data for data entry errors, omissions, outliers, and inconsistencies by comparing project documentation to the program tracking data

As part of the onsite verification visits, we completed the following:

- Verified installed measure quantities
- Verified deployment of HVAC control strategies and recorded their current operating ranges

Based on the sample of 15 desk reviews and 7 onsite verification visits, we found the following:

- **Fewer linear feet of refrigerated case doors verified onsite:** During onsite visits the evaluation team confirmed that for 1 project 20 linear feet of refrigerated case doors were no longer installed, leading to a 6% decrease. The project accounted for 8% of the sampled savings.
- **Incorrect average compressor efficiency:** For 4 projects, ex ante savings were calculated using an incorrect average compressor efficiency. As a result, ex post savings increased by 0.3% for the affected projects. Three projects accounted for 27% of the sampled Phase 1 savings and 1 project represents 36% of the sampled Phase 2 savings.
- **Abandoned refrigerated case loads with installed doors:** The evaluation team identified 1 project where ex ante energy savings mistakenly abandoned the load for 16 linear feet of refrigerated cases with doors. Project documentation indicates these refrigerated cases installed doors but were relocated due to reconfiguring the store layout. As a result, evaluated savings decrease by 6% for that project. The project accounted for 11% of the sampled savings.
- **Claimed savings for dismantling refrigerated cases:** For 1 project, ex ante claims savings for the removal of 44 linear feet of refrigerated cases without doors. The evaluation team disallowed savings from removing cases without doors since it is not an eligible program measure. As a result, evaluated savings decreased by 30% for that project. The project accounted for 7% of the sampled savings.

Table 27 summarizes the reported and evaluated electric energy savings for the other measures, along with the realization rate and associated relative precision at 90% confidence.

Table 27. Other End-uses Gross Impact Results

Phase	Ex Ante Savings (kWh)	Realization Rate	Relative Precision at 90% Confidence	Ex Post Savings[a] (kWh)
Phase 1	3,773,075	94%	7.2%	3,542,628
Phase 2	783,045	90%	10.5%	701,560
Total	**4,556,120**	**93%**	**6.2%**	**4,244,188**

[a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

4.3.6 Gas Savings

In addition to gas savings realized through the CBTU program, our gross impact evaluation for the gas fuel of the C&I Retrofit Compliance program included desk reviews and onsite verification visits for a sample of projects. Table 28 summarizes the participant population of projects along with the planned and completed number of desk reviews and onsite visits.

Table 28. Non-CBTU Gas Fuel Desk Review and Site Visit Summary

Phase	Number of Projects				
	Population	Planned Desk Reviews	Competed Desk Reviews	Planned Site Visits	Completed Site Visits
Phase 1	46	10	10	10	8
Phase 2	23	5	5		

As part of the desk reviews, we completed the following:

- Reviewed all project documentation including PSE worksheets, implementation inspection photos, invoices, and savings calculations
- Ensured contents of PSE's worksheets are consistent with product specifications and invoices
- Checked the data for data entry errors, omissions, outliers, and inconsistencies by comparing project documentation to the program tracking data.

As part of the onsite verification visits, we completed the following:

- Verified installed measure quantities
- Verified deployment of HVAC control strategies and recorded their current operating ranges

Based on the sample of 15 desk reviews and 8 onsite verification visits, we found the following:

- **Implemented control strategy operating ranges**: The onsite engineer verified the presence of supply air temperature reset control strategy. However, the verified operating minimum temperature setpoint was 55°F and not 62°F used in the ex ante savings calculations. The difference reduced savings by 5% for this project. The project accounted for 12% of the sampled gas savings.
- **High ex ante savings estimates**: Ex ante savings for 1 boiler project were unreasonably high. Per the project documentation, the boiler was installed for space heating purposes. Ex ante savings of 14,648 therms were developed using billing data regression analysis. To realize this level of savings, the boiler would either require a very long runtime or an existing efficiency much less than assumed 80%. For example, applying the algorithm for heating boilers from the Mid-Atlantic v8[8] assuming 8,760 hours, 80% baseline efficiency, 93% proposed efficiency, and actual 1,000,000 Btu/h capacity in pre and post, the annual therm savings are estimated to be 15,306 therms. The boiler is installed in a university building which likely does not require year-round heating at all 8,760 hours. The PSE documentation for this project also included a bin analysis savings estimate using part load operation assumptions, 75% existing efficiency, and 93% proposed efficiency which resulted in 8,534 therms. The evaluation team used the savings from the bin analysis as ex post, as they are

[8] Kish, L. (1995). *Survey Sampling.* Wiley Classics Library Edition.

more reasonable than the savings from the billing analysis. Such change resulted in the realization rate of 58% for that project. The project accounted for 5% of the sampled gas savings.

- **Baseline efficiency adjustment**: The evaluation team adjusted the existing boiler efficiency from 80% to 85% in 1 direct hot water (DHW) boiler. Project documentation indicated that the existing DHW boilers were Lochnivar Copper-Fin II Gas Boilers with 85% thermal efficiency. There is no discussion about diagnostic testing to measure actual efficiency. As a result, evaluated savings decreased by 42% for that project. The project accounted for 0.6% of the sampled gas savings.
- **Baseline temperature difference adjustment:** 1 project with gas savings resulting from replaced leaky hot water valves located in air-handlers used 0°F temperature difference ("delta T") for the post-retrofit conditions. However, the post-retrofit trend data and notes indicate there is still a small delta T (2°F in 1 air handler and 1°F in another) across the air stream caused by supply fan heat. The adjustment decreased savings for that project by 14%. The project accounted for 9% of the sampled savings.
- **Abandoned refrigerated case loads with installed doors:** The evaluation team identified 1 project where ex ante energy savings mistakenly abandoned the load for 16 linear feet of refrigerated cases with doors. Project documentation indicates these refrigerated cases installed doors before relocation due to reconfiguring the store layout. As a result, evaluated savings decrease by 6% for that project. The project accounted for 5% of the sampled savings.
- **Claimed savings for dismantling refrigerated cases:** For 1 project, PSE claimed ex ante savings for the removal of 44 linear feet of refrigerated cases without doors. The evaluation team disallowed savings from removing cases without doors since it is not an eligible program measure. As a result, evaluated savings decrease by 30% for that project. The project accounted for 5% of the sampled savings.

Table 29 summarizes the reported and evaluated therm energy savings for the gas measures, along with the realization rate and associated relative precision at 90% confidence.

Table 29. Non-CBTU Gas Fuel Gross Impact Results

Phase	Ex Ante Savings (Therm)	Realization Rate	Relative Precision at 90% Confidence	Ex Post Savings[a] (Therm)
Phase 1	527,631	89%	7.4%	469,272
Phase 2	166,008	87%	13.1%	144,022
Total	**693,639**	**88%**	**6.4%**	**613,294**

[a] Reflect savings for the sample frame as opposed to the population as of the end of the biennium.

5. Process Findings

Based on the evaluation team's review of the C&I Retrofit program theory and logic model (PTLM), the overall program design and performance metrics presented align with descriptions of each of the C&I Retrofit program offerings from PSE program staff. As such, the evaluation team sees no need for updates to the PTLM as a result of this evaluation. For reference purposes, a copy of the PTLM can be found in Appendix B of this report.

PSE program staff identified several common opportunities for improvement across C&I Retrofit subprograms during the 2018-2019 biennium. These opportunities included raising customer awareness of subprograms and program design changes, recruiting new customers to participate in subprogram offerings, and updating program designs to reflect changing market conditions. PSE program staff commonly streamlined application processes, coordinated program marketing materials and other components across programs where possible, and updated incentive structures to address these opportunities.

Although PSE does not formally report program performance by subprogram, program staff generally track energy savings and participation for each subprogram internally. Program staff reported that almost all C&I Retrofit subprograms performed to energy saving expectations.

Table 30 summarizes the program's performance across key performance indicators. As can be seen in the table, the program performed as expected in terms of the gas goals and slightly underperformed on the electric side. Customer participation was below goal.

Table 30. C&I Retrofit Program Performance Across Key Performance Indicators

Metric	Definition	Success Criteria	Ex Ante	Ex Post	KPI Status
Electric savings	Amount of MWh savings for 2018-2019	118,500 MWh[a]	94,389 MWh	94,927 MWh	Ex ante savings were slightly below the2018-2019 biennium goal, having reached 79.7% of the goal
Gas savings	Amount of therm savings for 2018-2019	825,000 therms[a]	826,936 therms	732,709 therms	Ex ante savings met 99.7% of 2018-2019 biennium goal
Customer Participation	Number of customers taking part in the program	3,600 customer sites[b]	1,199	1,199	Customer participation met 33% of the goal

[a] Source: Exhibit 1. PSE Conservation Rider. Savings Goals and Budgets.

[b] Source: 2019 Annual Conservation Plan (page 83). file:///C:/Users/kavseikova/Downloads/ees_2019_annual_conservation_plan.pdf

Sections below provide detailed process results for each of the 6 subprograms.

5.1 Industrial System Optimization

Subprogram Design

PSE designed the Industrial System Optimization subprogram (ISOP) to help targeted industrial customers identify and implement projects that result in operation and maintenance (O&M) energy improvements to

their buildings. The ISOP team delivers low-cost energy-saving solutions focused on energy-intensive systems, such as refrigeration, HVAC, compressed air, pumping, fans, and blowers. ISOP also offers incentives for Performance Tracking Systems (PTS). PSE delivers the subprogram with support from a third-party, Cascade Energy. PSE identifies customers that are a good fit for the subprogram and Cascade Energy is responsible for subprogram implementation. The team targets industrial facilities where the majority of electric load is associated with processing or manufacturing. These types of facilities often have subsystems that run long hours, rely on industry-standard technology, and keep relatively stable control setpoints and loads.

PSE and Cascade Energy conduct an onsite assessment with each potential participant to identify a list of potential O&M opportunities, establish a baseline for the facility's electric energy performance, and determine if the facility meets the potential energy-saving requirements to participate in the subprogram. After the program team completes this initial project scoping phase, each participant undergoes an optimization event where program and facility staff identify and implement O&M action items. After the optimization event, Cascade Energy provides the customer with an action plan report with recommended O&M procedures to increase energy efficiency at the participating site. PSE staff review reports and action plans and provide suggestions and recommendations to Cascade Energy during the planning process. The customer has up to 120 days to implement recommendations and O&M action items to receive the full incentive. After customers complete the action items, PSE monitors participant energy usage for 60 days to ensure that energy savings persist. Participants receive performance incentives based on PSE's verification of energy savings.

During the 2018 to 2019 biennium, PSE piloted a new offering Strategic Energy Management (SEM) offering for a subset of industrial customers who have already participated in ISOP. Cascade Energy supports PSE by recruiting SEM participants, providing technical oversight of data tracking and modeling efforts, identifying energy savings opportunities, and coaching participants' facility staff. PSE plans to roll out the SEM program as a full offering to industrial customers in the 2020-2021 biennium.

Subprogram Implementation and Performance

Table 31 provides a summary of the key ISOP subprogram changes, challenges, successes, and planned future implementation changes based on the evaluation team's discussion with program staff.

Table 31. ISOP Program Staff Interview Findings

Key Successes in 2018-2019	Key Challenges in 2018-2019	Key Implementation Changes in 2018-2019	Planned Implementation Changes in 2020-2021
▪ Helping industrial customers identify opportunities to achieve savings without having to make significant capital investments at their facilities. ▪ High customer satisfaction, program staff believe the subprogram provides a service that customers really want.	▪ There is a limited pool of industrial customers that are eligible to participate in the ISOP subprogram. ▪ The long industrial project cycle poses challenges to closing out projects within the 2-year subprogram cycle. ▪ Customers generally do not have the capacity to complete all the action	▪ PSE revised the incentive structure to reflect the amount of time participants take to complete the recommended action items. Customers who complete all action items within 120 days of receiving the list of action items will receive reimbursement up to	▪ PSE will begin to operate the ISOP subprogram in-house. ▪ The SEM component of ISOP will transition from a pilot offering to a separate program. ▪ ISOP will become part of a new initiative that is comprised of several subprogram offerings designed specifically for

▪ Program staff view the subprogram as a source of cost-effective savings.	items recommended to them through the subprogram. ▪ Difficulty recruiting more industrial customers to the SEM portion of the subprogram.	100% of the project cost. After the 120 days, customers may only be eligible to receive 50% of the project cost.	industrial customers called the Industrial Energy Management Program.

Overall, PSE program staff believed the ISOP subprogram performed to expectations during the 2018-2019 biennium. Staff reported that the savings results for this subprogram were stable and predictable over time, which allowed them to forecast annual subprogram savings accurately. The 2018-2019 biennium was no exception to this trend.

Program staff noted that ISOP performed very well in terms of electric savings; however the subprogram has never been able to yield any gas savings because dual-fuel participants receive gas services from other providers. PSE also informally tracks customer satisfaction through conversations with customers and customer feedback received from Cascade. Based on this feedback, staff feel that customers are generally satisfied with the subprogram offerings and participation process.

The evaluation team reviewed the PTLM for alignment with current subprogram implementation processes. Overall, the processes described in the ISOP PTLM align with PSE program staff descriptions of the subprogram. However, interviews with the ISOP program team revealed that some subprogram changes were not reflected in the PTLM. We recommend that the following subprogram processes should be updated in the ISOP PTLM:

- **Addition of SEM offering**: A subset of industrial customers who have already participated in ISOP also participate in the Enhance It subprogram. Enhance It provides a behavior-based approach to energy efficiency that focuses on O&M improvements;
- **Removal of Sensei**: PSE did not offer the Sensei energy management software; and
- **Addition of timeline for project completion**: The customer has 120 days to complete the project to receive the full incentive, customers that complete projects after 120 days are only eligible to receive 50% of the incentive.

Appendix B of this report contains the PTLM for this subprogram for reference purposes.

Subprogram-Specific Key Performance Indicators

Table 32 describes the current subprogram-specific KPIs for the program beyond the core KPIs.

Table 32. ISOP Program-Specific Key Performance Indicators

Metric	Definition	Success Criteria	Currently Collected by Program	Included in Evaluation Scope	Collection Method
Energy savings	MWh and therm savings	2018-2019 biennium goal: 6,500,000 MWh and 25,000 therms	Y	Y	Program tracking data

Metric	Definition	Success Criteria	Currently Collected by Program	Included in Evaluation Scope	Collection Method
Participation	Number of optimization events, number of completed action items	None specified	Y	Y	Program tracking data
Expenditure	Dollars spent	Not specified at subprogram level	Y	N	Program tracking data
Timing of savings	Number of days taken to complete action items	<=120	Y	N	Program tracking data
Customer satisfaction	Anecdotal assessments of customer service throughout program participation	Majority of participants reporting overall satisfaction with their participation	Informally	N	Not tracked

5.2 Comprehensive Building Tune-Up

Subprogram Design

PSE customers with a building larger than 50,000 square feet are eligible to participate in the Comprehensive Building Tune-Up (CBTU) subprogram. The subprogram offers incentives for commissioning and O&M improvements in existing buildings older than 18 months. This subprogram has specific participation requirements:

- Senior operations staff must go through approximately 50 hours of training depending on the building type and size.
- The participant must commit to investing a minimum of 10 cents per square foot for single-fuel customers, or 15 cents per square foot for dual-fuel customers to help ensure customers can realize energy savings.
- Projects must meet a 2-year payback requirement.

PSE assesses customers' suitability for the subprogram using a customer questionnaire about building use, an internal engineering analysis conducted by PSE staff, and a pre-approved commissioning provider's assessment of potential savings opportunities at the customer's facility. If the customer has the potential to save at least 10% of their building's overall energy consumption, then PSE continues with the assessment phase of the subprogram. PSE pays up to 100% of the assessment cost which can range from $2,000 and $5,000 depending on the building type. During the assessment phase, the commissioning provider verifies the information provided in the customer questionnaire and engineering analysis and confirms and quantifies the energy savings opportunities at the building. The commissioning provider also fine-tunes these analyses where necessary.

PSE uses the results from the CBTU assessment to determine which PSE Non-Residential Programs are the best fit for the customer. Customers that are not well-suited for CBTU are channeled to other PSE Non-Residential programs where appropriate. Customers that are approved for CBTU proceed with the commissioning phase of the sub-program. During the commissioning phase, a commissioning provider conducts a more thorough investigation of energy savings opportunities at the building and completes the

building commissioning and measure installation. As part of this process, the commissioning provider educates facility staff about the commissioning improvements and provides a facility guide that serves as a training manual for maintaining these improvements. Throughout the commissioning phase, participants also complete "persistence checks," where the participant provides PSE with data to verify that projects implemented through the commissioning process are achieving persistent savings. Subsequently, PSE staff verify that the completed interventions and measure installations are functioning appropriately. Upon completion of the verification phase, PSE distributes an initial incentive. The subprogram also incentivizes performance, and PSE program staff use participants' monthly billing data to complete a regression analysis to track energy savings and calculate annual performance incentives.

Subprogram Implementation and Performance

Table 33 provides a summary of the key CBTU subprogram changes, challenges, successes, and planned future implementation changes based on the evaluation team's discussion with program staff.

Table 33. CBTU Program Staff Interview Findings

Key Successes in 2018-2019	Key Challenges in 2018-2019	Key Implementation Changes in 2018-2019	Planned Implementation Changes in 2020-2021
▪ Additional commissioning providers showed an interest in the subprogram. ▪ Some customers completed large projects that exceeded expected savings forecasts.	▪ The subprogram follows standardized processes, which poses challenges for serving a diverse set of customers with different needs.	▪ Began working with Seattle City Lights as a new partner in subprogram delivery.	▪ PSE program staff will change the subprogram name from CBTU to Existing Building Commissioning to match the standard naming conventions in the commissioning community.

Conversations with program staff revealed that the CBTU subprogram continued to meet internal savings goals during the 2018-2019 biennium. Program staff believe there are opportunities to improve subprogram participation as that they feel that this subprogram has been historically underutilized compared to other offerings and they face ongoing challenges with recruiting customers to participate. Program staff suggested that recruitment challenges could be due to the standardized subprogram participation process, which poses challenges for serving customers who have a diverse set of needs.

Subprogram-Specific Key Performance Indicators

PSE program staff track multiple metrics to gauge the success of the CBTU program. PSE tracks metrics for each of the program's participation requirements including training hours, cost of implementation, and project payback period. In addition, participants must complete a commissioning report and facility guide which provide PSE with information about the actions the participant takes through the commissioning process. Participants also complete "persistence checks," where the participant provides PSE with data to verify that projects implemented through the commissioning process are achieving persisting savings. Additionally, program staff use participants' monthly billing data to complete a regression analysis, which allows program staff to track energy savings.

As shown in Table 34, the program is tracking most KPIs, has defined goals for them, and collects the data needed to track progress. Based on the design and implementation of this program, the evaluation team has no additional KPI suggestions for this offering at this time.

Table 34. CBTU Program-Specific Key Performance Indicators

Metric	Definition	Success Criteria	Currently Collected by Program	Included in Evaluation Scope	Collection Method
Energy savings	MWh and therm savings	Not specified at subprogram level	Y	Y	Program tracking data
Customer participation	Number of customers taking part in the program	None specified	Y	Y	Program tracking data
Expenditure	Dollars spent	Not specified at subprogram level	Y	N	Program tracking data
Training hours	Number of training hours for senior operations staff	The participant's senior operations staff must go through 50 hours of training	Y	N	Customer provides confirmation that requirement is met
Cost of implementation	Cents per square foot of implementation	10-15 cents per sq. ft. of implementation	Y	N	Customer provides confirmation that requirement is met
Project payback period	Time it takes for the project to pay for itself	Projects must meet a 2-year payback requirement	Y	N	Customer provides confirmation that requirement is met

5.3 Business Lighting

Subprogram Design

PSE offers the Business Lighting subprogram to customers to access custom grants for LEDs, linear lighting, and lighting control projects. PSE developed this subprogram to provide a streamlined process for customers to access grants for custom lighting projects.

Customer participation in the subprogram begins with the completion and submission of a project application. This application includes an Excel workbook, through which the applicant provides all information necessary to calculate deemed savings and the incentive amount for the proposed project, including details on pre-existing equipment, proposed new equipment, space conditions, and hours of operation. Upon customer submission of the project application, Energy Management Engineers (EME) review the application for completeness and accuracy. After the application verification, PSE and the customer enter into a contract which specifies the project details and the project incentive amount. PSE has differing internal project verification procedures dependent on project size:

- **For projects under 25,000 kWh**: PSE does not require pre- and post- verification visits because the realization rates from these projects tend to be very consistent. Instead, staff conduct a desk review verification using project invoices and other documentation to confirm that the equipment is

installed as specified. Program staff indicated that a significant portion of these smaller projects generally end up receiving verification visits as part of PSE's overall verification strategy to ensure that high realization rates are being maintained.

- **For projects of 25,000 kWh in savings or larger**: PSE requires a pre-installation verification visit to confirm that the project conditions and details are as specified. PSE also conducts a post-installation verification visit to ensure that the installed equipment matches the application and then pays the project incentive upon verification of project installation.
- **For exceptionally large projects of 300,000 kWh in savings or larger**: The verification process is the same as the process for projects that are 25,000 kWh or greater with the addition that PSE requires monitoring or metering to ensure that project characteristics match assumptions, such as confirmation that lighting hours of use are as specified. Once this verification is complete, PSE pays the project incentive.

Subprogram Implementation and Performance

Table 35 provides a summary of the key Business Lighting subprogram changes, challenges, successes, and planned future implementation changes based on the evaluation team's discussion with program staff.

Table 35. Business Lighting Program Staff Interview Findings

Key Successes in 2018-2019	Key Challenges in 2018-2019	Key Implementation Changes in 2018-2019	Planned Implementation Changes in 2020-2021
▪ PSE program staff made progress towards reducing project implementation timelines. ▪ The number of lighting controls installed through the subprogram increased.	▪ PSE reduced incentive levels for TLEDs in 2018 and added bonus incentives for Luminaire Level Lighting Controls (LLCs) of $75 in the hope that this would motivate participants to shift their purchases to more comprehensive lighting upgrades with the potential to achieve deeper savings. However, to date, PSE has found that TLEDs are still accounting for a substantial share of subprogram savings. ▪ Ensuring consistent understanding of eligible measures across all contractors and staff responsible for subprogram delivery.	▪ PSE moved to a standardized incentive level of 15 cents per kWh saved for installations, with a bonus incentive of $50 per fixture with LLCs. ▪ Tubular LEDs (TLEDs) are subject to a separate incentive structure of $2 per lamp regardless of type or size. ▪ Incentive levels for lighting controls increased from $50 to $75.	▪ TLED installation incentives will decrease from 15 cents to 12.5 cents if the installation is a partial retrofit. ▪ New fixture installation incentives will increase from 15 cents to 17.5 cents. ▪ Subprogram energy savings target will increase by 10%

Subprogram staff identified the ease of the Business Lighting participation process as a contributing factor to the subprogram's ongoing success.

Subprogram-Specific Key Performance Indicators

Table 36 describes the current KPIs for the program. Given the program's design and performance to date, the evaluation is not recommending any additional KPIs at this time.

Table 36. Business Lighting Program-Specific Key Performance Indicators

Metric	Definition	Success Criteria	Currently Collected by Program	Included in Evaluation Scope	Collection Method
Energy savings	MWh savings	2018-2019 biennium goal: 87,500 MWh	Y	Y	Program tracking data
Customer participation	Number of customers taking part in the program	None specified	Y	Y	Program tracking data
Expenditure	Dollars spent	$20,129,580	Y	N	Program tracking data

5.4 Retrofit Grants

Subprogram Design

PSE customers can access grants for custom non-lighting projects through the Retrofit Grants subprogram. This subprogram is flexible by design and allows customers to apply for grants for projects that span any measure or market segment. Typical measures include HVAC controls, chiller upgrades, and boiler upgrades. Subprogram staff determine project incentives by considering project cost, projected savings, and cost-effectiveness standards. PSE offers $0.30 per kWh and $5 per therm of projected annual energy savings, up to 70% of the total cost of equipment and installation.

Customers and contractors submit a custom grant application to PSE that includes customer information, project information (e.g., project description, facility square footage, projected energy savings, etc.), and supporting documentation. For all custom retrofit projects, EMEs develop an internal Scope of Work, which includes Measurement and Verification (M&V) plans, and details on how to calculate savings. EMEs estimate project savings using custom engineering calculations or regression analyses based on energy consumption data from the participating facility. Before issuing pre-approval for each project, EMEs review the Scope of Work document, conduct a pre-installation inspection to verify existing equipment conditions, and review the proposed efficiency upgrades. Upon completion of the project, EMEs conduct post-installation visits to verify the installed equipment.

Subprogram staff leverage long-term relationships with participating contractors, and internal PSE marketing and outreach channels to generate project leads and market the Retrofit Grants subprogram to PSE customers. Cross-promotional efforts include the Business Energy Management monthly newsletter, case studies, "Big Check" presentations, and sponsorship of industry events.

Subprogram Implementation and Performance

Table 37 provides a summary of the key Retrofit Grants subprogram changes, challenges, successes, and planned future implementation changes based on the evaluation team's discussion with program staff.

Table 37. Retrofit Grants Program Staff Interview Findings

Key Successes in 2018-2019	Key Challenges in 2018-2019	Key Implementation Changes in 2018-2019	Planned Implementation Changes in 2020-2021
▪ Program staff reported that the subprogram has been performing to expectations.	▪ Helping customers understand PSE's cost-effectiveness requirements. To address this issue, PSE Energy EMEs help participants assess the cost-effectiveness of proposed projects based on estimated energy savings and project costs. ▪ Construction in PSE's territory has slowed down leading to fewer channeling opportunities into the Retrofit Grants subprogram.	▪ PSE worked to align its marketing materials and collateral across all C&I programs. ▪ PSE developed a prescriptive incentive based on square footage, energy savings, and facility type for Variable Refrigerant Flow (VRF) projects in May 2019.	▪ Incentive for gas measures to include condensing equipment on roof-top units. ▪ Increase in electric incentive levels per kWh. ▪ Development of targeted marketing tactics for market actors including contractors, architects, engineering firms, and professional organizations.

PSE program staff reported that overall the subprogram performed to expectations. PSE do not track specific internal savings and participation metrics for this subprogram.

Subprogram-Specific Key Performance Indicators

The table below describes the current KPIs for the Retrofit Grants subprogram. The subprogram tracks core KPIs (e.g., savings and customer participation) associated with program performance. As such, the evaluation team is not recommending the addition of supplemental KPIs at this time.

Table 38. Retrofit Grants Program-Specific Key Performance Indicators

Metric	Definition	Success Criteria	Currently Collected by Program	Included in Evaluation Scope	Collection Method
Energy savings	MWh and therm savings	Not specified at subprogram level	Y	Y	Program tracking data
Customer participation	Number of customers taking part in the program	None specified	Y	Y	Program tracking data
Expenditure	Dollars spent	Not specified at subprogram level	Y	N	Program tracking data
Onsite inspections	Number of pre- and post-installation inspections	None Specified	Y	N	Program tracking data

5.5 Advanced Rooftop Controls

Subprogram Design

PSE administers the Advanced Rooftop Controls (ARC) subprogram in coordination with Seattle City Light, Snohomish County PUD, and Tacoma Power. The design of the subprogram encourages participants to install controls on existing single-zone packaged rooftop units (RTU) by offering fixed per ton incentives for electric and gas savings that cover up to 70% of the project cost. ARC offers advanced features including integrated air-side economizers, variable fan drives, and demand-controlled ventilation. Eligible RTUs must be less than 15 years old, with constant speed supply fans and nominal cooling capacity of 5 tons or greater.

Participants fill out an application for the ARC subprogram through their electric utility, which then forwards subprogram documentation on to the participant's gas utility to calculate and process any gas savings and rebates associated with the ARC project. PSE manages the implementation of the ARC subprogram internally. PSE EMEs process each ARC project as a standard rebate based on regional technical form and savings size. As such, ARC projects are subject to the same criteria as all custom projects administered through other PSE programs.

Subprogram Implementation and Performance

Table 39 provides a summary of the key ARC subprogram changes, challenges, successes, and planned future implementation changes based on the evaluation team's discussion with program staff.

Table 39. ARC Program Staff Interview Findings

Key Successes in 2018-2019	Key Challenges in 2018-2019	Key Implementation Changes in 2018-2019	Planned Implementation Changes in 2020-2021
▪ Improved working relationships with partner utilities – Seattle City Light, Snohomish County PUD, and Tacoma Power which enabled program staff to become more responsive to solving issues and making adjustments to rebate offerings. ▪ Built relationships with distributors and other market actors which helped to raise awareness of the subprogram.	▪ Low subprogram participation and recruitment of subprogram participants continued to be a challenge. ▪ Building contractor awareness about the new ARC-Lite streamlined offering remained less than anticipated.	▪ Program staff added a simplified and less expensive version of the full ARC offering called ARC-Lite. ARC-Lite does not require ARCs to have the demand-controlled ventilation feature. ▪ The workbook application requirement changed to a 2-page application to encourage more contractors to participate. ▪ PSE transitioned the ARC subprogram incentive design from a custom grant structure to a prescriptive-based rebate format.	▪ PSE is exploring an ARC offering for single-phase RTUs that are commonly installed in smaller commercial facilities. ▪ The ARC incentive will change from $275 per ton to $1250 for each piece of HVAC equipment that receives a controls upgrade.

Program staff reported that ARC subprogram generally underperformed against goals. Program staff actively worked to improve subprogram outcomes during the 2018-2019 biennium by expanding efforts to educate contractors about the ARC subprogram and streamlining the application process. Program staff also plan to change the incentive structure from the current per ton incentive to an incentive for each piece of HVAC equipment that receives a controls upgrade, which has proven to be successful in another jurisdiction.

Subprogram-Specific Key Performance Indicators

Energy and gas savings are the primary metrics that PSE program staff use to measure performance for this subprogram. Program staff expressed an interest in developing additional performance metrics – such as participation, contractor knowledge and awareness, and the number of contractors offering ARC services – to help measure success and guide program delivery in the future. The evaluation team agrees that these KPIs should be added to the list of measures used to assess program performance and outlines how this data will be collected as part of the evaluation in Table 40.

Table 40. ARC Program-Specific Key Performance Indicators

Metric	Definition	Success Criteria	Currently Collected by Program	Included in Evaluation Scope	Collection Method
Energy savings	MWh and therm savings	Not specified at subprogram level	Y	Y	Program tracking data
Customer participation	Number of customers taking part in the program	None specified	Y	Y	Program tracking data
Expenditure	Dollars spent	Not specified at subprogram level	Y	N	Program tracking data
Contractor knowledge and awareness	Contractor knowledge and awareness of ARCs	Increased program participation	N	Y	2018 Evaluation Contractor Engagement Assessment[a]
Contractor participation	Number of contractors offering ARC services	Increased program participation	N	Y	2018 Evaluation Contractor Engagement Assessment[a]

[a] Recommended by the evaluation team.

5.6 Major HVAC Controls Grants

Subprogram Design

PSE's Major HVAC Controls subprogram provides grants to PSE C&I customers who add or update 3 or more substantial HVAC control sequences. Subprogram participants are also eligible to receive additional HVAC upgrades including a web-based graphical user interface and HVAC controllers. Project incentives vary depending on the services provided by PSE (electric, gas, or combined), energy use of the participating facility, and verified savings. PSE offers a prescriptive base incentive once participants install upgrades and a performance incentive after the system is in place for at least ten months. Combined base and performance incentives may cover up to 50% of the project cost.

Contractors fill out a general application and checklist that outlines existing building systems and proposed upgrades. As part of the training process, contractor staff provide a facility guide that includes a breakdown of the building's HVAC control system settings, setpoints, and schedules. PSE EMEs review the application and perform an initial site visit to determine the current state of existing controls and to verify the checklist that the contractor provided. The contractor then updates the control sequences, installs additional HVAC upgrades, and provides training to the facility staff about the upgrades. PSE conducts a post-installation site

visit to confirm project completion, which includes verifying that the customer received building operations training from the contractor. The customer receives a base incentive upon completion of the site visit. PSE also performs a 5-month review after initial project completion to check system performance and to verify that the control sequence updates and installed equipment are functioning correctly. PSE completes a final review at 10 months which includes performing a regression analysis using billing data to determine any necessary adjustments to the calculations and modeling. These results from this analysis help calculate the performance incentive.

Subprogram Implementation and Performance

Table 41 provides a summary of the key Major HVAC Controls subprogram changes, challenges, successes, and planned future implementation changes based on the evaluation team's discussion with program staff.

Table 41. Major HVAC Controls Program Staff Interview Findings

Key Successes in 2018-2019	Key Challenges in 2018-2019	Key Implementation Changes in 2018-2019	Planned Implementation Changes in 2020-2021
▪ Standardization of the M&V process resulted in increased transparency and faster completion of internal M&V processes. ▪ Average site-level increased from approximately 15% to 25% of overall energy consumption per site. ▪ Customer recruitment efforts were successful and customer participation increased.	▪ Building contractor awareness of subprogram M&V processes and incentive structure. ▪ Developing appropriate regression analyses to ensure savings are measured accurately.	▪ Final regression analyses now leverage normalized models with TMY3 Data. ▪ PSE began offering a performance incentive based on regression analysis results using 10 months of post-period data to incentivize participants to continuously use controls effectively. ▪ Incentive structures changed from a custom grant structure to a dual incentive structure where customers are eligible to receive 1 prescriptive incentive and 1 performance incentive.	▪ Program staff will offer a streamlined portion of Major HVAC Controls for smaller buildings under 50,000 square feet. The new path will eliminate any controls sequences that are not applicable to smaller buildings and reduce the amount of functional testing and training that participants are required to complete.

Interviews with program staff revealed that the Major HVAC Controls subprogram achieved an average reduction in consumption per site of 25% which exceeds internal goals of 15% average savings. Subprogram participation also increased relative to previous subprogram years. Program staff attributed this success to the standardization of the M&V process. Also, program staff also reported hearing positive feedback about the incentive changes as participants appreciated the stability of the guaranteed prescriptive incentive and the added opportunity to achieve additional rewards for maximizing savings with the performance inventive.

Subprogram-Specific Key Performance Indicators

Table 42 describes the current KPIs for the program. As shown, electricity savings and gas savings are the primary metrics used by program staff to measure performance. Given the program's design and performance to date, the evaluation is not recommending any additional KPIs at this time.

Table 42. Major HVAC Controls Program-Specific Controls Key Performance Indicators

Metric	Definition	Success Criteria	Currently Collected by Program	Included in Evaluation Scope	Collection Method
Energy savings	MWh and therm savings	Not specified at subprogram level	Y	Y	Program tracking data
Customer participation	Number of customers taking part in the program	None specified	Y	Y	Program tracking data
Expenditure	Dollars spent	Not specified at subprogram level	Y	N	Program tracking data

Appendix A. Detailed Sample Design and Results Extrapolation Methodology

The evaluation team relied on simple random and stratified random sample designs to support the engineering desk reviews and verification site visits. In case of the stratified random sample design, we leveraged Dalenius-Hodges Method determine strata boundaries and Neyman Allocation Method to optimally allocate available sample into each stratum. We describe each method below. Following the description, we detail realization rate calculation and standard error propagation method for each sampling approach. Determination of Strata Boundaries Using the Dalenius-Hodges Method.

The Dalenius-Hodges method begins with the creation of numerous and narrow strata. Within each stratum, the frequency of coupons, f(y), is calculated. Next, the square root of f(y), $\sqrt{f(y)}$, is calculated and the cumulative of $\sqrt{f(y)}$ is formed. The total of cumulative $\sqrt{f(y)}$ is then divided by the number of desired strata to determine the division points on the cumulative $\sqrt{f(y)}$ scale.

The above rule assumes equal widths, d, for the class intervals, and it must be modified when the class intervals have variable widths dy. The approach recommended by Kish[9] is to multiply the f(y) by the width of the interval, take the square root of this value, and cumulate the values $\sqrt{d_y f(y)}$. Finally, as in the above case, the total of cumulative $\sqrt{d_y f(y)}$ is then divided by the number of desired strata to determine the division points on the cumulative $\sqrt{d_y f(y)}$ scale.

Optimal Allocation Using the Neyman Allocation Method

Once strata boundaries have been determined, an allocation scheme is used to estimate the population mean with the lowest variance for a fixed total sample size n under stratified random sampling. Such a scheme is the Neyman allocation as described in Cochran.[10]

$$n_h = n \frac{N_h s_h}{\sum N_h s_h}$$

where:

N_h = the total number of units in stratum h

n_h = the number of units in the sample of stratum h

n = the total number of units in the sample across all strata

s_h = the variance within stratum h

This formula for optimal allocation may produce an n_h in some stratum that is larger than the corresponding Nh. This problem can arise in the plan for the verification of rebate program savings since the overall sampling

[9] Kish, L. (1995). *Survey Sampling.* Wiley Classics Library Edition.
[10] Cochran, W. G. (1977). *Sampling Techniques.* Hoboken: John Wiley & Sons, Inc.

fraction is large and some strata are much more variable than others. If the original allocation gives, for example, a n_1 that is greater than N_1, then equation 1 is revised as follows:

$$n_h = (n - N_1)\frac{N_h s_h}{\sum_2^L N_h s_h}$$

If the original allocation gives, for example, an n1 that is greater than N1 and an n2 that is greater than N2, then equation 2 is revised as follows:

$$n_h = (n - N_1 - N_2)\frac{N_h s_h}{\sum_3^L N_h s_h}$$

Using the approach just described, the sample design for all of our samples was expected to provide statistically valid impact results at least at the 90% confidence level ±10% for the projects overall based on demand.

Simple Random Sample Ratio-Model Approach

The evaluation team implemented the following approach to calculate ratios (realization rates) for the projects sampled using simple random sampling design.

Equation 2. Simple Random Sample Ratio

$$r = \frac{\overline{y}}{\overline{x}}$$

where:

r = ratio of evaluated to reported sample estimates, or the realization rate

$\overline{y}$ = sample ex post mean

$\overline{x}$ = sample ex ante mean

The standard error of the ratio estimate is given by:

Equation 3. SRS Standard Error of Ratio Estimate

$$\widehat{SE}(r) = \left(\frac{r}{\sqrt{n}}\right)\left(V_x^2 + V_y^2 - 2\rho_{xy}\hat{V}_x\hat{V}_y\right)^{1/2}\sqrt{\frac{N-n}{N-1}}$$

where:

N = population of properties

n = sample of properties

$\hat{V}_x^2 = \left(\frac{N-1}{N}\right)\left(\frac{s_x^2}{\overline{x}^2}\right)$

$\hat{V}_y^2 = \left(\frac{N-1}{N}\right)\left(\frac{s_y^2}{\overline{y}^2}\right)$

s_x = reported standard deviation of sample

s_y = evaluated standard deviation of sample

Stratified Ratio Estimator Adjustment Method

The evaluation team implemented the following approach to calculate ratios (realization rates) for the projects sampled using stratified random sampling design.

$$r_{strc} = \frac{\bar{y}_{str}}{\bar{x}_{str}}$$

Where:

$r_{strc} =$ stratified-combined ratio of ex post to ex ante sample estimates, or realization rate

$\bar{y}_{str} =$ stratified sample ex post mean

$\bar{x}_{str} =$ stratified sample ex ante mean

The variance of the ratio is given by:

$$Var(r_{strc}) = \left(\frac{1}{N^2\bar{X}^2}\right)\sum_{h=1}^{L}\frac{N_h^2(N_h - n_h)}{n_h(N_h - 1)}\sigma_{hz}^2$$

$N_h =$ Number of participants in population of stratum h

$n_h =$ Number of participants in sample of stratum h

$\bar{y}_h =$ Estimated ex post sample mean in stratum h

$\bar{x}_h =$ Estimated ex ante sample mean in stratum h

And

$$\sigma_{hz}^2 = \sigma_{hy}^2 + R^2\sigma_{hx}^2 - 2R\rho_{hxy}\sigma_{hy}\sigma_{hx}$$

Where:

R = Ratio or realization rate

$\hat{\sigma}_{hy}^2 =$ Estimated variance of the phase 2 in stratum h

$\hat{\sigma}_{hx}^2 =$ Estimated variance of the ex ante savings in stratum h

$\hat{\rho}_{hxy} =$ Estimated correlation between X and Y in stratum h

The standard error is calculated as the square root of the variance.

Appendix B. Program Theory and Logic Models

Figure 1. C/I Retrofit PTLM

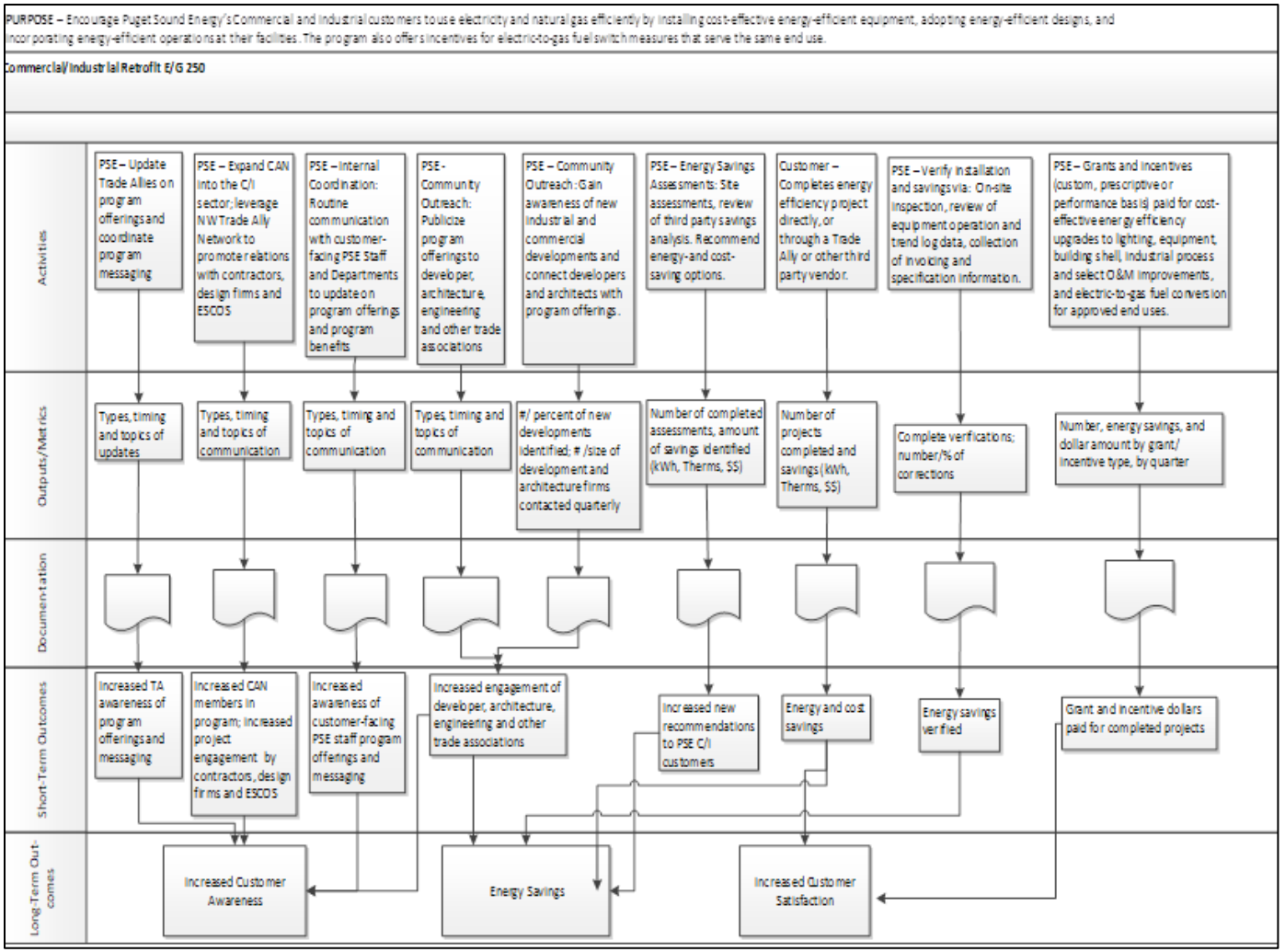
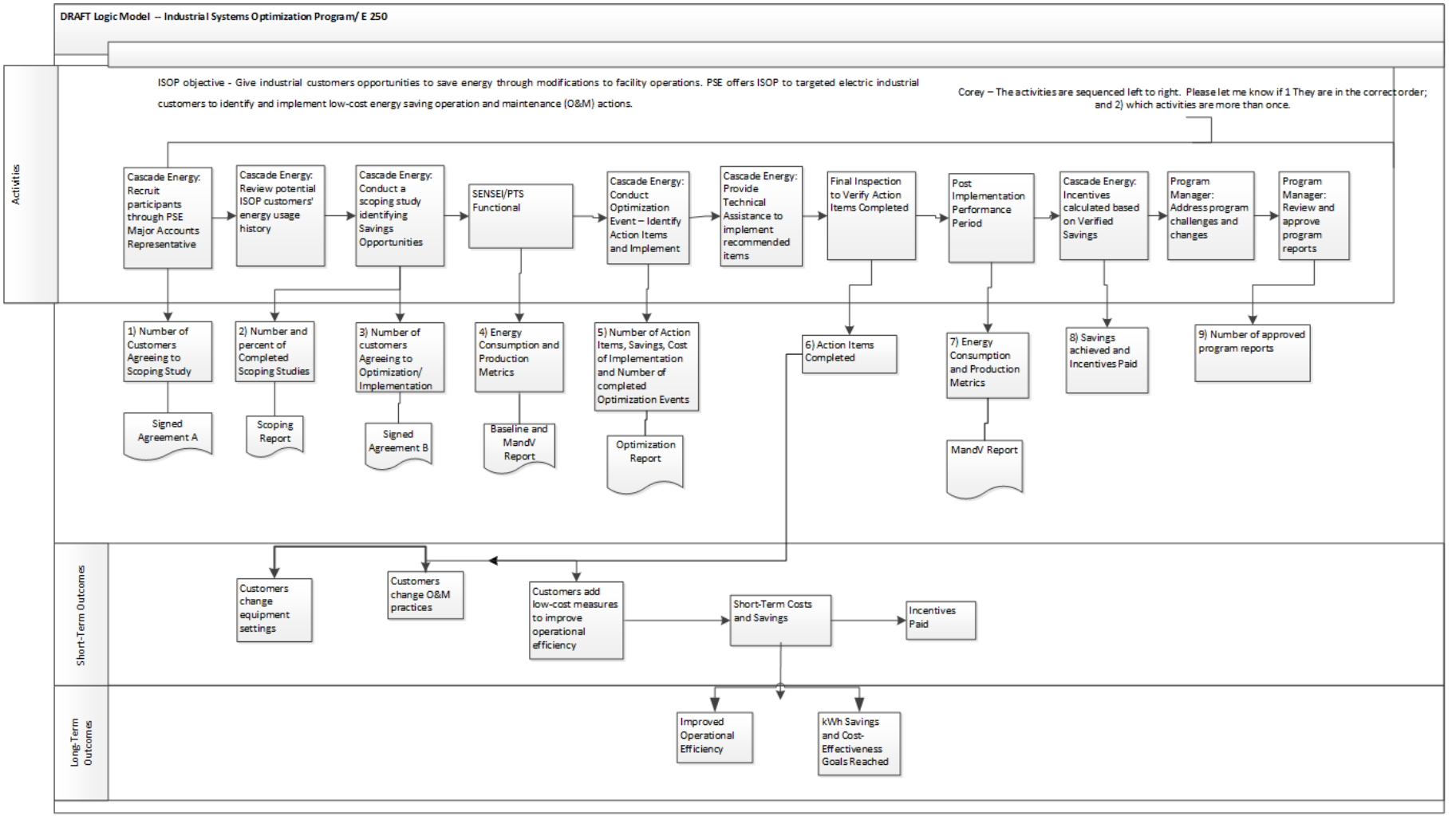


Figure 2. ISOP PTLM



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PUGET SOUND ENERGY

Evaluation Report Response

Commercial and Industrial Retrofit Program, 2018-19

A. Overview

Puget Sound Energy's (PSE's) Commercial and Industrial (C&I) Retrofit Program offers incentives to C&I customers for making energy-efficient capital upgrades and adopting energy-efficient operation and maintenance (O&M) practices. Customers can access incentives through multiple subprograms covering a variety of energy-efficient upgrades, including (but not limited to) lighting, building shell, HVAC, industrial process, and O&M improvements. PSE administers the following subprograms under the broader C&I Retrofit program:

- The Industrial Systems Optimization Program (ISOP) helps industrial customers make operation and maintenance (O&M) energy improvements to their buildings. Notably, during this biennium, PSE piloted a new offering under ISOP called Strategic Energy Management (SEM).
- The Comprehensive Building Tune-up (CBTU) subprogram helps customers in large buildings make commissioning and O&M improvements and helps train building operations staff. Notably, during this biennium, CBTU staff began working with Seattle City Lights as a new program delivery partner.
- The Business Lighting subprogram helps customers access grants to install energy efficiency lighting and lighting controls.
- The Retrofit Grants subprogram helps customers access grants to install non-lighting equipment that typically involves HVAC controls, chiller upgrades, and boiler upgrades.
- The Advanced Rooftop Controls (ARC) subprogram helps customers install controls on packaged rooftop units.
- The Major HVAC Controls subprogram helps customers install HVAC control sequences.

PSE hired Opinion Dynamics Corporation (ODC) to evaluate the program's performance throughout the 2018-2019 biennium. The primary objective was to evaluate the electric and gas savings associated with the program. Additionally, ODC explored whether the Program Theory and Logic Models accurately reflected the current program design and documented any key program changes as well as the program's success and challenges from the perspective of key program management staff. ODC derived evaluation findings in the report from multiple evaluation activities including 25 in-depth interviews with key program management staff, a review of program materials and tracking data, a review of the program's theory and logic model, and an extensive engineering analysis of energy savings based on a desk review of 113 projects and site visits to 50 participating customers.

B. Summary of Evaluation Results

Overall, the realization rate for the C&I Retrofit Program was found to be 101% for the electric savings and 89% for gas savings. The majority of the electric savings in the Program came from Lighting equipment, which accounted for 69% of ex ante electric savings. The majority of the gas savings came

from a combination of equipment including compressed air, refrigeration, and water heating equipment, which accounted for 56% of ex ante gas savings.

On the electric side, ODC verified 100% of PSE's estimated savings for ISOP and CBTU and 99% of electric savings for estimated for motors. They found more savings than PSE estimated for lighting equipment (102% realization rate) but found slightly less savings than PSE's estimates for controls, HVAC, and other equipment types (realization rates of 96%, 96%, and 93%, respectively).

On the gas side, the realization rate was 92% for CBTU projects and 88% for other gas-saving measures. Due to relatively small contribution of the CBTU measures to the total savings, the final program-level realization rate for gas savings is weighted heavily toward the non-CBTU measures.

C. **Evaluation Considerations and Recommendations and Program Responses**

Recommendation #1*: Include measure quantity data and subprogram type in the program tracking data.*

"Our review of the program tracking databases revealed that PSE thoroughly tracks completed projects and collects the necessary project detail, such as customer information, project dates, detailed measure description, savings, and incentives. However, Program tracking data lacked 2 key data fields:

- Incented measure quantity – the field was in the data but it was not populated with information. The lack of this information precludes the ability to track the quantity of measures installed against the quantity expected which is helpful in monitoring and assessing the program performance throughout a given program year.
- Subprogram type – the field was not in the data and the evaluation team, as a result, could not link all projects to specific subprograms. Without this link, the evaluation team could not design a sampling strategy for each sub-program for the engineering analyses. Having a dedicated field referencing the subprogram(s) associated with each project provides two key benefits: 1. This would better enable PSE Program management staff to track and monitor subprogram performance against goals throughout a biennium and make decisions throughout implementation in response; and 2. This would enable evaluation to assess the savings performance of each subprogram against goals, understand the reasons why a subprogram over or underperformed against expectations, and recommend ways to garner more energy savings on a subprogram level. "

PSE Response *(From Kasey Curtis, Evaluation Senior Analyst):* In the case of incented measure quantities, several of PSE's incented measures are custom measures based on whole-building and engineering calculations. As such, they might include several measures including lighting, HVAC, etc., but savings are reported as one number, the "project" savings. As such, programs will avoid entering measure quantities so as not to confuse internal data tracking systems. In other applications, for example the cost-effectiveness model, this is overcome by simply adding a "1" in the measure quantity field for custom projects. To assist future evaluations, PSE will review the program tracking data with the evaluators, and ensure that these custom projects contain the value necessary for tracking savings. In the case of this evaluation, the lack of measure quantity did not affect the savings calculations for the C/I portfolio.

As to the subprogram type, this again did not affect the savings calculations in this evaluation, but ODC is correct to point out that it would make subprogram tracking easier to include that field. As such, the Evaluation team will work with EE's systems and information group to see if the subprogram type can be added to the data extracts.

Recommendation #2: *Update the ISOP program theory logic model (PTLM) to include recent changes to the ISOP program.*

"We recommend that the following subprogram processes are updated in the ISOP PTLM:

- **Addition of SEM Offering**: A subset of industrial customers who have already participated in ISOP also participate in the Enhance It subprogram. Enhance It provides a behavior-based approach to energy efficiency that focuses on O&M improvements;
- **Removal of Sensei**: PSE did not offer the Sensei energy management software; and
- **Addition of Timeline for Project Completion**: The customer has 120 days to complete the project to receive the full incentive, customers that complete projects after 120 days are only eligible to receive 50% of the incentive."

PSE Response: The 2018/19 ISOP program has been retired and replaced by a revamped and expanded the ISOP program for the 2020-21 biennium superseding the referenced logic model. Current program documentation is available at https://www.pse.com/rebates/business-incentives/energy-management-programs/industrial-system-optimization-program .

Recommendation #3: *Ensure the program savings used are the latest versions from the RTF, and that lighting calculators are updated with the most recent HVAC interaction factors.*

"Savings Calculations

- Apply the savings from the RTF version available during PSE's deemed savings planning period (e.g., September prior). PSE applied savings to anti-sweat heater (ASH) controls from an older version of the Regional Technical Forum (RTF) (v.2.2 instead of v3.1).[1]
- Ensure all lighting projects use the lighting calculator with the most updated HVAC interaction factors."
- Monitor performance savings to ensure that baseline savings are removed to avoid double counting.

[1] Version – 2.2 is dated January 2016.Version 3.1 is dated November 2016.

PSE Response

- In order to maintain consistency among multiple program delivery mechanisms, PSE used savings values established in the active business case at the time these projects were constructed. Business cases are updated regularly as part of PSE's planning process. As such, PSE savings claims for similar custom grant measures will use the same claims found in the active business case for that program period.
- HVAC interaction factors are regularly reviewed and updated. The Business Lighting HVAC factors were calculated from the BPA/RTF factors and adjusted using PSE territory factors.
- PSE disagrees with this project evaluation/recommendation.

  The referenced project was originally created as a two-part base/performance HVAC controls project. During the course of the project, PSE revised the grant to be a performance-only controls measure. The base savings and incentive payment was cancelled (as documented in PSE's project management and tracking program) and a new grant that combined the base savings and performance savings was issued. Project closeout then occurred using PSE's standard pre-and post-installation bill history regression analysis. Since the original base savings was not claimed, it is valid to claim all savings from the measure implementation.

  As this project was verified and closed out using a post-installation bill history regression analysis, the realization rate for this project should be 100%.

Consideration #1: *Add additional KPI metrics that include participation, contractor knowledge, and the number of contractors offering ARC services.*

"Energy and gas savings are the primary metrics that PSE program staff use to measure performance for this subprogram. Program staff expressed an interest in developing additional performance metrics – such as participation, contractor knowledge and awareness, and the number of contractors offering ARC services – to help measure success and guide program delivery in the future. The evaluation team agrees that these KPIs should be added to the list of measures used to assess program performance." ARC, P. 40

PSE Response: PSE has expanded its marketing and outreach efforts in order to increase awareness and encourage program participation for all offerings. As many HVAC contractors offer multiple energy efficiency measures (ARC included), awareness of this offering is expected to increase.

PSE routinely assesses program performance through regularly scheduled forecasting meetings and will consider adding specific measure KPI's as appropriate.