EVERGREEN ECONOMICS

Biennial Electric Conservation Achievement Review (BECAR) of the Puget Sound Energy 2018-2019 Electric Conservation Program Portfolio

FINAL Report

May 11, 2020

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Executive Summary

In 2018, the Washington Utilities and Transportation Commission (WUTC) issued Order 01 in Docket UE-171087 approving PSE's 2018-2019 biennial conservation target, subject to conditions. Part of this process involves selecting a third-party independent consultant to complete the Biennial Electric Conservation Achievement Review (BECAR) process, with the consultant being managed by PSE and WUTC staff, with additional input from the Conservation Resource Advisory Group (CRAG). In May 2018, PSE selected the Evergreen Economics team as the third-party consultant to conduct the BECAR process for the 2018-2019 biennium.

The following are the primary objectives of the 2018-2019 BECAR:

- Provide independent review of unit energy savings (UES) values and their application to PSE program measures;
- Verify that PSE's reported annual savings corresponds to program tracking data; and
- Review and provide recommendations on PSE's responses to evaluation recommendations and previous BECAR recommendations.

This report is the last report in the 2018-2019 BECAR cycle and summarizes the methods, findings, and recommendations resulting from the Evergreen team's review of the 2018 and 2019 program year achievements.

Methodology

There were four primary tasks completed for the 2018-2019 BECAR period and one optional task that was not needed in this review. These tasks include:

1. **Unit Energy Savings review.** As the first task in the BECAR process, the Evergreen team conducted a review of the deemed UES values that were in use for PSE's 2018 and 2019 conservation programs. The objectives of this review were to ensure that UES values were being applied correctly in the tracking data, that the most current and accurate values were being used, and that the values relied on assumptions that were appropriate for the measure application.
2. **Portfolio savings audit.** This task comprises a review of PSE's portfolio savings as they appeared in the PSE Annual Report for 2018 and 2019. The objective of this task was to confirm that PSE's reported savings matched what was recorded in the program tracking data.
3. **Previous BECAR recommendation response review.** For this task, the Evergreen team compiled and reviewed the recommendations that were made in the 2016-2017 BECAR report. We then contacted PSE staff as needed to follow up on what actions, if any, have been taken to address these recommendations and what actions are planned for the future. Finally, the Evergreen team made a determination as to

whether the recommendation has been adequately addressed, or if additional action is needed.

4. **Evaluation report response review.** The Evergreen team reviewed the Evaluation Report Responses (ERRs) for the 2018 and 2019 program evaluation reports, and compiled the recommendations and PSE responses contained in each. For each program, we reached out to the PSE staff as needed to find out what actions have been taken to follow up on the recommendations since the completion of the ERR.
5. **In-depth review of selected energy savings.** As an optional task, this is reserved for special cases where additional review of measures beyond what is covered in the other four tasks is necessary. For the 2018-2019 BECAR period, no measures or programs were identified by PSE, WUTC, or the CRAG for in-depth review of energy savings, so this optional task was not conducted.

Conclusions and Recommendations

Based on the findings of the reviews described above for the 2018-2019 biennium, we have developed a number of conclusions and associated recommendations to improve PSE's energy savings estimates, program management, and evaluation research. These are organized below by BECAR task.

Unit Energy Savings Review

Overall, we found that the UES values in use by PSE were applied correctly and were based on reasonable assumptions. Specific recommendations were made in an interim memo and PSE has since responded to those recommendations. There are no additional recommendations at this time for updating the measure-specific UES values.

Past BECARs have recommended that PSE improve the documentation for the UES values by creating more straightforward links between the specific measure named in the tracking data and the related business case documentation. PSE has begun the process of improving its tracking systems to link the business case documents to the program tracking data, we recommend that progress on this be assessed as part of an UES review completed as part of the next BECAR.

Recommendation: Include a review and assessment of how well the business case documentation is linked to the tracking data as part of the UES review task in the next BECAR.

Portfolio Savings Audit

The Evergreen team conducted an audit of PSE's portfolio savings as they appeared in the PSE 2018 Annual Report compared to a year-end extract of PSE's tracking data. This process was repeated for 2019 using PSE's tracking data and comparing it against the portfolio savings in the final savings tables that will be used in PSE's 2019 Annual Report. We were able to confirm the total kWh values matched those reported by PSE for both years.

Previous BECAR Recommendation Response Review

The Evergreen team found that all recommendations made in the 2016-2017 BECAR Final Report have since been addressed or PSE has adequately explained their reasoning for not pursuing follow-up to those recommendations.

The process of documenting and reviewing the BECAR recommendations every two years has resulted in a smoother review process that has consistently improved PSE's savings estimation practices and documentation over time. The result is that there are fewer general BECAR recommendations as the procedures are in good shape. As a result, more of the focus of this BECAR was directed to the evaluation recommendations, which are specific to individual programs.

Recommendation: Continue tracking BECAR recommendations and responses.

Evaluation Report Response Review

Given the timing of some of the evaluation reports, it was not possible for all of the recommendations to be addressed by the time the current BECAR ended. While PSE has taken reasonable steps to begin addressing all of the evaluation recommendations, the adequacy and effectiveness of their actions may not be known until the next time the program is evaluated. This is especially true for recommendations relating to changing program implementation, which will need to be assessed during the next program evaluation based on customer feedback in order to determine if the initiated actions have been effective. In order that follow up continues for these longer term recommendations, we recommend that they be explicitly tracked as part of each BECAR, with progress assessed once a new evaluation report becomes available. Having future evaluations identify specific research issues that originated from the BECAR process would help with tracking progress in these areas.

Recommendation: Continue with evaluation review tracking and identify longer-term recommendations that should be specifically addressed in future evaluations.

Recommendation: Review the status of longer-term recommendations that were identified in this BECAR that should be addressed in future evaluations, which are summarized in Table 7 and copied verbatim in *Appendix A*.

1 Introduction

In 2018, the Washington Utilities and Transportation Commission (WUTC) issued Order 01 in Docket UE-171087 approving PSE's 2018-2019 biennial conservation target, subject to conditions. Part of this process involves selecting a third-party independent consultant to complete the Biennial Electric Conservation Achievement Review (BECAR) process, with the consultant being managed by PSE and WUTC staff, with additional input from the Conservation Resource Advisory Group (CRAG). In May 2018, PSE selected Evergreen Economics as the third-party consultant to conduct the BECAR process for the 2018-2019 biennium.

The programs and electricity savings for both 2018 and 2019 are summarized in Table 1.

Table 1: Summary of 2018 and 2019 Programs and Savings

Program/Measure Name	2018 Sum of Total kWh from Tracking Data	2019 Sum of Total kWh from Tracking Data
Residential Energy Management		
Low Income Weatherization	1,900,832	2,648,830
Fuel Conversion Rebate	498,839	-
Residential Lighting	72,225,580	75,827,875
SF Existing Space Heat	8,051,272	9,292,658
SF Existing Water Heat	658,617	534,157
HomePrint	4,861,476	5,650,930
Home Appliances	4,108,239	2,481,141
Web-Enabled Thermostats	1,114,219	958,557
Residential Showerheads	2,492,665	1,368,760
SF Existing Weatherization	1,926,078	1,890,226
Home Energy Reports	24,106,986	-6,110,919
Single Family New Construction	14,322	137,837
Manufactured Home New Construction	20,691	90,408
Multi-Family Retrofit	11,433,281	13,001,543
Multi-Family New Construction	1,267,063	6,165,221
Total Residential Programs*	**134,680,160**	**113,937,229**

Program/Measure Name	2018 Sum of Total kWh from Tracking Data	2019 Sum of Total kWh from Tracking Data
Business Energy Management		
Commercial Industrial Retrofit	15,427,266	8,946,480
Business Lighting – Grants	45,611,570	46,010,269
Industrial System Optimization	4,377,103	4,110,143
Energy Smart Grocer	439,113	-
ESG New Construction	118,955	-
Commercial Industrial New Construction	13,398,526	17,038,372
Commercial Strategic Energy Management	11,474,335	15,349,891
High Voltage Program Non 449	18,750,039	446,060
High Voltage Program	13,631,197	-
Business Lighting – Markdowns	11,789,734	11,360,946
Commercial Kitchen & Laundry	171,445	382,525
Commercial HVAC	1,209,679	623,352
Commercial Midstream	182,783	1,082,861
Small Business Direct Install	14,099,207	6,666,949
Total Business Programs*	**150,680,952**	**112,017,850**
Regional Efficiency Programs		
NW Energy Efficiency Alliance	10,774,800	11,300,000
Generation Transmission and Distribution	3,782,018	670,392
Total Regional Programs*	**14,556,818**	**11,970,392**
Grand Total*	**299,917,930**	**237,925,471**

*Totals may not match due to rounding

With these programs and savings levels as context, the following are the primary objectives of the 2018-2019 BECAR:

- Provide independent review of UES values and their application to PSE program measures;

- Verify that PSE's reported annual savings corresponds to program tracking data; and
- Review and provide recommendations on PSE's responses to evaluation recommendations and previous BECAR recommendations.

To achieve these objectives, a number of different data sources were used to support the reviews described in this report:

- **2016-2017 BECAR Final Report.** This report details the activities, findings, and recommendations of the previous BECAR cycle.
- **2018-2019 Biennial Conservation Plan.** The current PSE Biennial Conservation plan describes the programs and measures offered and activities undertaken by PSE in the 2018-2019 program years.
- **2018 Annual Conservation Report.** This report summarizes PSE's achievements resulting from the 2018 conservation programs and activities. It includes information on expenditures, savings, cost effectiveness, and evaluation, measurement, and verification activities.
- **2019 Annual Conservation Report – Savings Tables.** For the 2019 savings verification, the totals from the program tracking data were compared with the final savings tables provided by PSE for their upcoming 2019 Annual Conservation Report. This report is expected to be published in June 2020.
- **PSE staff interviews.** A handful of phone interviews and email exchanges were conducted with PSE program staff to determine the current status of actions taken to address previous BECAR and evaluation recommendations.
- **PSE program tracking database extracts.** PSE provided data extracts covering the entire 2018 and 2019 program years.
- **Business case documentation.** Business cases containing information on measure savings, assumptions, and calculations were provided by PSE and reviewed by the BECAR team.
- **Evaluation Report Responses (ERRs).** The BECAR team reviewed ERRs completed by PSE in 2018 and 2019. These were for evaluations covering earlier program years that have been completed since the last BECAR report. ERRs for the following evaluations were reviewed:
    - 2017 & 2018 Home Energy Reports Program Impact Evaluation (2 reports)
    - 2015-2016 Resource Conservation Manager Program Impact and Process Evaluation
    - 2017-18 Multifamily Retrofit Program Evaluation
    - 2017-18 Web-Enabled Thermostats Program Evaluation
    - 2017-2019 Home Energy Assessment Program Evaluation

The remainder of this report is organized as follows. The *Methods and Findings* chapter describes the various review tasks that were conducted for the 2018-2019 BECAR final report and the findings that resulted from these reviews. The *Conclusions and Recommendations* chapter summarizes the key conclusions and our recommendations to PSE for improving both future evaluations and the BECAR process. Additional detail on the evaluation recommendations (and PSE's responses) are included in *Appendix A*.

2 Methods and Findings

This chapter presents the methods and findings of each of the tasks completed for the 2018 BECAR period:

1. Unit energy savings review;
2. Portfolio savings audit;
3. Previous BECAR recommendation response review;
4. Evaluation report response review; and
5. In-depth review of selected energy savings (if needed)

Each of these tasks are described in the sub-sections below.

2.1 Unit Energy Savings Review

As the first task of the 2018-2019 BECAR process, the Evergreen team conducted a review of the deemed unit energy savings (UES) that were in use for PSE's 2018 and 2019 conservation programs. The objectives of this review were to ensure that UES values were being applied correctly in the tracking data, that the most current and accurate values were being used, and that the values relied on assumptions that were appropriate for the measure application. The first review was conducted in the summer of 2018 and the second during the summer of 2019.

The first step in the UES review was to request from PSE a summary of the program measures installed year-to-date at the time of the request (i.e., summer). This included detail on the program, measure type, quantity installed, per unit savings, total savings, source of savings, version start and end date, and measure lifetime. Based on this year-to-date (YTD) data, we selected a subset of measures for further review under this task. Measures were prioritized for review if they had deemed UES values, made up a large portion of YTD savings, had a source of savings other than the RTF, and/or were recommended for additional review in a previous BECAR report. The selection also included a variety of measure types, including HVAC, envelope, and lighting measures. The list of selected measures was provided to PSE with a request for business case and savings calculation documentation.

For the 2018 review, the 19 measures selected for review along with their source of savings, UES value, 2018 year-to-date savings (as of July 2018), and summary of documentation provided by PSE are summarized in Table 2 below.

Table 2: Measures Selected for 2018 UES Review

EES Measure ID	End Use	Measure Name	Source of Savings	UES Value (kWh)	2018 YTD Savings (kWh)	Percent of 2018 YTD Savings	Documents Received
5470	Residential Lighting	Lamp - LED - Reflector	PSE Deemed	28.05	10,450,936	9.2%	Yes**
5783	Residential Lighting	Lamp - LED - A Lamp	PSE Deemed	11.32	8,053,909	7.1%	Yes**
5938	Home Energy Reports	Home Energy Report - Original - E	PSE Deemed	290.00	5,800,000	5.1%	Yes
5467	Residential Lighting	Lamp - LED - Candelabra	PSE Deemed	22.49	2,258,401	2.0%	Yes**
5757	Commercial Lighting	Fixture - LED - Retrofit Kit	PSE Deemed	25.61	1,937,960	1.7%	Yes***
6215	Commercial Lighting	Fixture - LED - 100w - from 400w HID	PSE Deemed	1,163.50	1,739,061	1.5%	Yes***
4923	Commercial Lighting	Fixture - LED - Retrofit Kit - Hard Wired Recessed Can	PSE Deemed	110.00	1,732,830	1.5%	Yes***
5480	Residential Lighting	Fixture - LED - T8	PSE Deemed	28.63	1,274,579	1.1%	Yes**
5738	Single Family Existing Space Heat	Ductless Heat Pump	RTF-deemed	2,659.00	1,163,214	1.0%	Yes*
5764	Commercial Lighting	Lamp - TLED - 2 3 or 4 foot	PSE Deemed	30.00	990,660	0.9%	Yes***
2444	Single Family Existing Space Heat	Heat Pump Conversion - FAF - 8.5 or greater HSPF - 14 SEER	RTF Deemed	3,528.00	980,784	0.9%	Yes*
5721	Residential Lighting	Lamp - LED - Reflector - BR30 - DI	PSE Deemed	39.41	818,546	0.7%	Yes***
5762	Commercial Lighting	Lamp - LED - Integral - Omnidirectional	PSE Deemed	79.00	722,060	0.6%	Yes***
4741	Home Energy Assessments	Lamp - LED - A Lamp - DI	PSE Deemed	20.67	699,287	0.6%	Yes***
4963	Single Family Existing Space Heat	Ductless Heat Pump (as of 4/1/17)	RTF Deemed	2,659.00	467,984	0.4%	Yes*

EES Measure ID	End Use	Measure Name	Source of Savings	UES Value (kWh)	2018 YTD Savings (kWh)	Percent of 2018 YTD Savings	Documents Received
5792	Residential Shower Heads	Aerator - WaterSense - C - Any WH - 1.0 gpm	PSE Deemed	24.49	435,664	0.4%	Yes*
5981	Multifamily Retrofit	Windows - DP to DP - U30 to U60 - E	RTF Deemed	12.30	425,051	0.4%	Yes***
2358	Home Appliances	Clothes Washer - Replacement - EWH - E Dryer - Top Load - APPR	PSE Deemed	809.00	185,261	0.2%	Yes***
4788	Multifamily Retrofit	Showerhead - Thermostatic Restrictor - EWH	PSE Deemed	1,859.00	137,566	0.1%	Yes**
Total					**40,273,751**	**35.3%**	

*Only business case document was provided
**Only Excel tool/workbook was provided
***Both business case document and Excel tool/workbook were provided

PSE provided either business case documentation or Excel workbooks and tools for all measures requested, as shown above in Table 2. For measures for which PSE provided business cases or Excel files, the documentation was reviewed to assess the:

- Accuracy in arithmetic for all calculations (limited to those measures for which we received calculations);
- Appropriateness of input assumptions;
- Correct application of the UES value in the source of savings document to the PSE tracking system; and
- Status of any updates based on the 2016-2017 BECAR recommendations related to UES values.

Additionally, for all measures in the 2018 YTD summary, we conducted a cursory review of UES values and measure lifetimes to ensure that all seemed to be within a reasonable range. We also compared the per unit savings shown in PSE's 2018-2019 Biennial Conservation Plan to the values shown in the tracking data to confirm that the corresponding savings are being used. Based on this review the BECAR team concluded that PSE was applying the UES values appropriately in 2018.

The 2019 UES review was completed using the same process, and the 18 measures selected for review along with their source of savings, UES value, and 2019 year-to-date savings are included in the tables below.

Table 3: **Electric Measures Selected for 2018 UES Review**

EES Measure ID	End Use	Measure Name	Source of Savings	UES Value (kWh)	2018 YTD Savings (kWh)	Percent of Total 2018 kWh YTD Savings
10008	Res Lighting	RETL: Lamp - LED - A Lamp	RTF Derived	11.3	13,350,200	13.4%
10014	Res Lighting	RETL: Lamp - LED - Reflector	RTF Derived	28.1	13,280,693	13.4%
10003	Res Lighting	RETL: Fixture - LED - Retrofit Kit	RTF Derived	25.6	4,125,488	4.2%
10009	Res Lighting	RETL: Lamp - LED - Candelabra	RTF Derived	22.5	2,923,228	2.9%
11269	Res Lighting	MFRFT: Lamp - LED - A Lamp - Direct Install	RTF Derived	10.2	1,179,013	1.2%
10011	Res Lighting	RETL: Lamp - LED - Globe	RTF Derived	12.9	1,010,309	1.0%
10001	Res Lighting	RETL: Fixture - LED - Indoor	RTF Derived	18.2	609,428	0.6%
10692	SF Heat Pump	SFEH: Ductless Heat Pump	RTF UES Deemed	2659.0	518,505	0.5%
10609	Res Lighting	RETL: Fixture - LED - T8	RTF Derived	28.6	412,472	0.4%
10736	SF Heat Pump	WET: Thermostat - Web Enabled - Retail - kWh	Evaluation Study	382.7	395,705	0.4%
11299	MF Space Heat	MFRFT: Windows - SP to DP - U30 to U120 - E	RTF UES Deemed	12.1	367,816	0.4%
10697	SF Heat Pump	SFEH: Heat Pump Conversion - FAF - 8.5 or greater HSPF - 14 SEER	Combination	3528.0	310,464	0.3%
10701	Res Water Heat	SFEWH: Heat Pump Water Heater - Tier 3 - NEEA Specs	RTF UES Deemed	1360.6	243,545	0.2%
11250	MF Space Heat	MFRFT: Insulation - Attic - R11 to R38 - E	RTF Derived	0.3	180,778	0.2%
Total					**38,907,643**	**39.15%**

Table 4: Gas Measures Selected for 2018 UES Review

EES Measure ID	End Use	Measure Name	Source of Savings	UES Value (Therms)	2018 YTD Savings (Therms)	Percent of Total 2018 Therm YTD Savings
11865	Res Space Heat	SFGH: Gas Fireplace - High Efficiency	Evaluation Study	110	280,610	17.5%
11866	Res Space Heat	SFGH: Gas Furnace - 95pc	Evaluation Study	17	120,108	7.5%
10709	Res Space Heat	SFWIN: Windows - Single Pane - to U30 - NG	RTF Derived	0.3	41,386	2.6%
10941	Res Space Heat	SFWX: Sealing - Duct and Insulation - NG	RTF Derived	38	33,975	2.1%
10737	Res Space Heat	WET: Thermostat - Web Enabled - Retail - Therm	Evaluation Study	72	31,248	1.9%
Total					**507,327**	**31.59%**

2.1.1 UES Recommendations and PSE Responses

Based on this review, our UES-related recommendations are listed below along with responses provided by PSE.

Recommendation: Incorporate the EES Measure ID or other obvious identifier into the business case documentation to serve as a clear link between measures described in the business case documents and the measures that appear in the tracking data.

PSE response: PSE reviewed the business case process and assessed the feasibility of incorporating EES Measure ID as a link between business cases, workbooks and tracking databases, and enforcement of version control. This assessment and a work plan were completed in Q4 2018.

Recommendation: Consider tracking changes in the business case documents and PSE deemed savings workbooks in a central location. As code standards change, it is important to track baseline changes to ensure that measure savings are up to date. Tracking changes will allow for more transparent review of measure savings in the future.

PSE Response: In the 3rd quarter of 2019, PSE fully reviewed each measure to ensure the accuracy of any measure changes, and PSE staff aligned numerous measures with similar attributes.

As a result of a new measure case process implemented in 2019 there is now consistency between measure cases, program planners, and PSE's data tracking with respect to measure version consistency and alignment. The measure cases remain the official source

of savings documentation; baseline updates and other changes affecting savings values are captured in the measure cases and carried over to PSE's Measure Library.

2.2 Portfolio Savings Audit

This section presents the savings verification results for the 2018-19 BECAR process and covers the PSE programs for both 2018 and 2019. The objective of this BECAR task was to confirm that PSE's reported savings matched what was recorded in the program tracking data.

Our review process for both years followed these steps:

1. PSE provided Evergreen with an extract of their program tracking database showing the count and savings for individual measures for each program for 2018 and 2019.
2. PSE provided a copy of its Annual Report that showed the total savings reported for each program year. For 2018, this was the Final Annual Report (*2018 Annual Report of Energy Conservation Accomplishments)* and for 2019 this included the final savings tables that will be included in their upcoming Annual Report (expected in June 2020).
3. Evergreen aggregated the tracking data to obtain the total savings for each program or measure using the *ElectricOrderNumber* and *ElectricOrderName* fields in the tracking data as the aggregating variables.
4. Evergreen compared its own savings totals aggregated from the tracking data with those PSE published in its Annual Report.

For both program years, we were able to confirm that the PSE tracking data savings values matched those reported in the Annual Report.

We have no recommended changes to reported savings for either year.

2.2.1 2019 Savings Verification

The results of our verification of PSE's 2019 reported savings by program are shown in Table 5. The results include references to the final savings tables that we used to confirm the savings totals against the tracking data. For all programs, we were able to confirm the total kWh values reported by PSE matched the total program savings from the tracking data. As noted below, in some cases there were discrepancies with how the savings were broken out and reported by sub-program but this did not affect the verification as the total program savings values matched. We were also able to confirm that the 2019 total savings number of 237,925,471 kWh reported in PSE's final savings tables matched the total savings compiled from the tracking data.

Table 5: Summary of Reported Savings Verification by Program/Measure (2019)

Program/Measure Name	Sum of Total kWh from Tracking Data	Report Table	Notes
Low Income Weatherization	2,648,830	Res. Energy Mgmt	
Residential Lighting	75,827,875	Res. Energy Mgmt	
SF Existing Space Heat	9,292,658	Res. Energy Mgmt	
SF Existing Water Heat	534,157	Res. Energy Mgmt	
HomePrint	5,650,930	Res. Energy Mgmt	Listed as Home Energy Assessment in Report
Home Appliances	2,481,141	Res. Energy Mgmt	
Web-Enabled Thermostats	958,557	Res. Energy Mgmt	
Residential Showerheads	1,368,760	Res. Energy Mgmt	
SF Existing Weatherization	1,890,226	Res. Energy Mgmt	
Home Energy Reports	-6,110,919	Res. Energy Mgmt	
Single Family New Construction	137,837	Res. Energy Mgmt	
Manufactured Home New Construction	90,408	Res. Energy Mgmt	Listed as Energy Star Manufactured Home in report
Multi-Family Retrofit	13,001,543	Res. Energy Mgmt	
Multi-Family New Construction	6,165,221	Res. Energy Mgmt	
Commercial Industrial Retrofit	8,946,480	Bus. Energy Mgmt	Included in CI Retrofit total in report
Business Lighting – Grants	46,010,269	Bus. Energy Mgmt	Included in CI Retrofit total in report
Industrial System Optimization	4,110,143	Bus. Energy Mgmt	Included in CI Retrofit total in report
Commercial Industrial New Construction	17,038,372	Bus. Energy Mgmt	
Commercial Strategic Energy Management	15,349,891	Bus. Energy Mgmt	

Program/Measure Name	Sum of Total kWh from Tracking Data	Report Table	Notes
High Voltage Program Non 449	446,060	Bus. Energy Mgmt	Listed as Large Power User – Self Directed Non 449 in report
Business Lighting – Markdowns	11,360,946	Bus. Energy Mgmt	Listed as Lighting to Go in report
Commercial Kitchen & Laundry	382,525	Bus. Energy Mgmt	
Commercial HVAC	623,352	Bus. Energy Mgmt	
Commercial Midstream	1,082,861	Bus. Energy Mgmt	
Small Business Direct Install	6,666,949	Bus. Energy Mgmt	
NW Energy Efficiency Alliance	11,300,000	Reg. Efficiency Programs	
Generation Transmission and Distribution	670,392	Reg. Efficiency Programs	Listed as Electric Generation, Transmission, and Distribution in report
Grand Total*	**237,925,471**	Exhibit 1 Savings and Expenditures	

*Totals may not match due to rounding

2.2.2 2018 Reported Savings

The results of our verification of PSE's 2018 reported savings are shown in Table 6, and these numbers were previously reported as part of the BECAR 2018-2019 Mid-Cycle Report. The results include the table reference from the 2018 Annual Report that we used to confirm the savings totals against the tracking data.

In some instances, programs were tracked as sub-programs within the tracking data and then the savings were aggregated in the Annual Report. These instances are noted in the table below, and in all these cases we were able to replicate the savings included in the Annual Report for the aggregated program totals.

Table 6: Summary of Reported Savings Verification by Program/Measure (2018)

Program/Measure Name	Sum of Total kWh from Tracking Data	Report Table	Notes
Web-Enabled Thermostats	1,114,219	Table IV-1	

Manufactured Home New Construction	20,691	Table III-1	SF and Mfr NC combined in Table III-1
Single Family New Construction	14,322	Table III-1	SF and Mfr NC combined in Table III-1
Multi-Family Retrofit	11,433,281	Table III-1	
NW Energy Efficiency Alliance	10,774,800	Table VIII-1	
Home Appliances	4,108,239	Table IV-1	
Residential Showerheads	2,492,665	Table IV-1	
Residential Lighting	72,225,580	Table IV-1	
Home Energy Reports	24,106,986	Table IV-1	
Multi-Family New Construction	1,267,063	Table III-1	
Commercial Midstream	182,783	Table VI-9	
Low Income Weatherization	1,900,832	Table III-1	
Fuel Conversion Rebate	498,839	Table III-1	
HomePrint	4,861,476	Table IV-1	Listed as Home Energy Assessments in report
SF Existing Water Heat	658,617	Table IV-1	
SF Existing Weatherization	1,926,078	Table IV-1	
SF Existing Space Heat	8,051,272	Table IV-1	
Commercial Industrial Retrofit	15,427,266	Table V-1	Included in CI Retrofit total in report
Generation Transmission and Distribution	3,782,018	Text on p. 16	
Business Lighting - Markdown	11,789,734	Table VI-9	
Commercial Industrial New Construction	13,398,526	Table V-1	2 comm NC categories combined in report totals
Commercial Kitchen Laundry	171,445	Table VI-9	
Commercial HVAC	1,209,679	Table VI-9	
High Voltage Program	13,631,197	Table V-1	2 high voltage programs combined in report
High Voltage Program Non 449	18,750,039	Table V-1	2 high voltage programs combined in report

Commercial Strategic Energy Management	11,474,335	Table V-1	Listed as RCM in report
Business Lighting - Grants	45,611,570	Table V-1	Included in CI Retrofit total in report
Industrial System Optimization	4,377,103	Table V-1	Included in CI Retrofit total in report
Small Business Direct Install	14,099,207	Table VI-9	
Energy Smart Grocer	439,113	Table V-1	Included in CI Retrofit total in report
ESG New Construction	118,955	Table V-1	2 comm NC categories combined in report totals
Grand Total	**299,917,930**	**Table II-1**	

*Totals may not match due to rounding

2.3 Previous BECAR Recommendation Response Review

The Evergreen team compiled and reviewed the recommendations that were made in the previous BECAR covering the 2016-2017 biennium. We then contacted PSE staff to follow up on what actions, if any, have been taken to address these recommendations. If we found that the recommendations had not yet been addressed, we inquired as to whether there are any plans to take action in the future and if not, the reason for not addressing the recommendation. We then made a determination as to whether the recommendation has been adequately addressed, or if additional action is needed.

Each recommendation from the 2016-2017 BECAR report is presented verbatim below (in italics), followed by the response from PSE and Evergreen's assessment of the actions taken to address the recommendation. The BECAR recommendations are organized below by the following two categories:

1. Future improvements in savings estimation
2. Future improvements in PSE adaptive management and BECARs

2.3.1 Future Improvements in Savings Estimation

PSE and RTF UES Reviews

Recommendation Context: The 2016-17 BECAR team undertook the review of a large group of Residential Energy Management (REM) and Business Energy Management (BEM) UES values from July through September 2016. Review of residential sector UES values found that: there were no errors that required correction and the derivations are consistent with the requirements of WAC 480-109-100, Washington's administrative code

governing energy efficiency activities for investor-owned utilities.[1] Review of the business sector UES values yielded similar findings: no errors required correction and the derivations are reasonably consistent with the requirements of WAC 480-109-100.[2]

Continue unit energy savings and business case reviews: *UES values account for about 67% of the BEM and REM sectors' savings in 2017. Our mid-2016 UES review found some inconsistency in PSE's baseline wattage assumptions for REM LEDs, which were then modified. Four of the evaluation report responses (ERRs) reviewed in Section 2.4 note occasional anomalies with using appropriate deemed values, data collection, and program data tracking; program staff report that these findings have all been addressed and corrected. Further, our observations in mid-2017 on a limited number (business case workbooks tend to be updated late in the year) of recently updated business case reviews indicate that UES business case documentation is improving markedly. However, given the magnitude of PSE portfolio savings associated with UES values and the supporting business case data, we think it is wise to continue these reviews.*

Recommendation 1: *Conduct additional review of a sample of UES measures and associated business cases in the 2018-2019 BECAR cycle. We recommend these reviews be started by July 2018, so that any modifications would be in time for the 2019 program planning cycle that begins in September 2018.*[3]

- **PSE Response:** A sample of UES measures and associated business cases are being reviewed as part of the current 2018-2019 BECAR cycle. The draft results of the latest UES measure review were completed by September 2018.
- **Evergreen Assessment:** We confirm that this recommendation was addressed in the current 2018-2019 BECAR cycle, the results of our review our presented in elsewhere in this report.

Commercial Rebates Program Measures

Recommendation Context: The 2016-17 BECAR team found that the HVAC interaction factors are not applied to deemed savings for lighting measures in the Small Business Direct Install (SBDI) and Lodging Direct Install (LDI) programs savings calculations. PSE's reason for this is that the recommendation came too late in 2017 for the program to change for the 2018 program year. They confirmed that the current business cases for SBDI and LDI still omit HVAC interaction factors and recommended that the program correct this for the 2019 program year with interaction factors based on RTF values, similar to what the BEM large commercial lighting program did in 2017.[4]

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[1] *Puget Sound Energy 2016-17 Biennial Electric Conservation Achievement Review (BECAR) Final Report*, April 24, 2018, pg. 16.
https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=197&year=2015&docketNumber=152058
[2] Ibid, pg. 17.
[3] Ibid, pg. 27.
[4] Ibid, pg. 74.

Apply HVAC interaction factors to applicable Commercial Rebates Program measures: *The Commercial Rebates evaluation found that the Lodging Direct Install and the Small Business Direct Install programs are using UES values for interior LED lighting without HVAC interaction factors; this results in overstated savings.*

Recommendation 2*: Revise the UES values for interior LED lighting in the Lodging Direct Install and Small Business Direct Install programs to account for HVAC interaction factors using RTF data.*[5]

- **PSE Response:** HVAC factors were not used in Lighting To Go and Small Business Direct Install (SBDI) as these programs do not know the heating type of the project before the deemed savings are calculated. Both programs are designed to reduce the barrier for customers and recalculating the deemed savings after each project greatly complicates the program. Business Lighting calculated an average of 1.01 for a HVAC factor for 2016-2017-2018 projects paid through December 2018. The Business Lighting HVAC factor were calculated from the BPA/RTF factors but used only the PSE territory factors. This factor is close enough to 1.0 that applying the factor to SBDI and Lighting To Go did not seem appropriate.

- **Evergreen Assessment:** This recommendation and response were also reviewed as part of the UES measure review that our team conducted as part of this BECAR cycle in 2018. We found that the average HVAC interaction factor of -0.085 that is currently in use by PSE appears to be derived from the average of electric and gas interactive effects, and is indeed close to the RTF value. The relative effect of this difference on savings appears to be minor. We believe that this recommendation has been adequately addressed.

Lighting To Go Deemed Savings Baselines

Recommendation Context: The 2016-17 BECAR team made a recommendation in the 2016-17 BECAR Interim Report and repeated it in the 2016-17 BECAR Final Report as it had not yet been addressed.[6] The original finding from the Interim Report is pasted below:

> *For Lighting To Go Integral LEDs and SBDI Screw-In LEDs, PSE derived the incandescent portion of the blended (CFL and incandescent) baseline from manufacturer's recommended incandescent equivalent wattages; these are pre-EISA wattages. Based on the EISA effective dates and the average life of incandescent bulbs, we believe that post-EISA wattages should be used when establishing baseline incandescent wattages. This issue was discussed at length during the August 16 and September 8 teleconferences. Participants in those calls agreed that without further research, PSE did not have the necessary market data to update the baselines accurately. In 2017, PSE is tracking current baseline fixture field data for the*

[5] Ibid, pg. 28.
[6] Ibid, pg. 19.

SBDI program and will apply that information for the 2018 program year LED UES savings assumptions. The Lighting To Go program may use baseline data currently under development by the RTF that should be available by September 2017 for inclusion in the 2018 program year UES values. When the RTF data becomes available, PSE will review the data for applicability to PSE's customer base. This approach was presented to the CRAG on May 31 and accepted as reasonable. The BECAR team will follow this process.

Update the Lighting To Go deemed value baselines with most current RTF values. *In the 2016 BECAR Interim Report, we recommended that the Lighting To Go program consider using RTF baseline data for LED lighting when it becomes available; however this was delayed by the RTF and therefore PSE was unable to modify the baseline for the 2018 program year.*

Recommendation 3*: When this RTF baseline data becomes available, we recommend PSE update the LED UES values accordingly.*[7]

- **PSE Response:** PSE is not adopting the RTF baseline values at this time due to concerns that the hours of use rely on a Pennsylvania study that does not reflect Pacific Northwest conditions and that the mix of lamps used to develop the baseline appears to contain a large proportion of LEDs. In addition, Lighting To Go currently doesn't collect the building type or the hours of operation in the program. These variables would be needed to update the calculation. The current baseline is based on CBSA hours of operation.

  In keeping with PSE's adaptive management orientation, as we develop post EISA baseline options PSE will review and assess new information as it becomes available. For example, new CBSA data will be available in late 2019 or early 2020.

- **Evergreen Assessment:** This recommendation and response were also reviewed as part of the BECAR 2018 UES. We believe the PSE response is reasonable and recommend that PSE continue to review new data as they become available as described in the response above.

Indoor Agriculture Baseline Research

Recommendation Context: The 2016-17 BECAR team reviewed the evaluation recommendations for the Commercial and Industrial New Construction program and confirmed that the PSE BEM team uses a baseline factor of 3.3 for vegetative growth spaces and 1.8 for flowering spaces. These baseline factors are a multiplier used to calculate savings for indoor agriculture lighting projects, and they represent the assumed ratio of baseline wattage to installed wattage. The 2016-17 BECAR team concluded this is a reasonable assumption for now. They also stated, "As the savings from this end use represent significant savings in the BEM portfolio, at a later date it would be helpful to conduct a survey of indoor horticultural cannabis growers in the region to verify baseline

[7] Ibid, pg. 28.

common practice assumptions for lighting power densities in flower and vegetative spaces."[8]

Conduct research and develop a standard baseline for BEM indoor agriculture new construction projects. *Unlike other new construction lighting measures, the Washington State Energy Code does not set a lighting power density baseline for indoor agriculture. PSE program staff determine baseline kW for these projects through interviews with growers about the lighting technologies they would have used absent utility incentives. Indoor agriculture projects represent about 10% of the entire BEM sector savings, and this is an expanding and relatively new commercial industry now addressed by utility incentive structures. In the interest of proactive adaptive management, it would be instructive to conduct a survey of indoor horticultural growers in the region, with the goal of establishing a rigorous set of best practice savings estimation protocols to ensure an accurate accounting of savings for this significant end use.*

Recommendation 4*: Conduct a survey of regional indoor agriculture operators to gain an understanding of which lighting technologies, absent utility incentives, would have been used for new horticultural operations. Similarly, do a literature search to find any studies that already may have been done on this subject. Based on the results of this research, baseline recommendations will be presented to PSE for consideration.*[9]

- **PSE Response:** While PSE has not conducted a formal survey of growers in the region, PSE engineers have continuously been working with multiple growers in many different phases of facility buildout, from New Construction to facility expansion and direct retrofit of existing lights. While working with many individual growers since 2013, PSE engineers noticed that the majority of facilities installing Non-LED lights were installing 1000W High Pressure Sodium and 1000W Metal Halide fixtures in both their vegetative and flowering growth rooms.

  Based on this information from PSE engineers, and discussions with growers, other utility professionals, and horticulture lighting manufacturers, it became apparent that the low cost and proven performance of 1000W HID lighting is the efficient grow light standard for indoor Vegetative and Flowering growth. PSE has standardized the baseline for New Construction Projects to be 1000W High Pressure Sodium and 1000W Metal Halide, with lower watt LED fixtures as the energy efficient alternative.

  PSE no longer relies on individual growers descriptions of the lighting system the growers would install in the absence of utility incentives. PSE now calculates baseline energy usage for New Construction Projects based on HID lighting systems.

[8] Ibid, pg. 72.
[9] Ibid, pg. 28.

- **Evergreen Assessment:** We believe the PSE response is reasonable and recommend that PSE continue to review new data as they become available.

2.3.2 Future Improvements in PSE Adaptive Management and BECARs

Recommendation Context: It was the 2016-17 BECAR team's opinion that the iterative changes to the BECAR process over the past four biennia have resulted in a process that adds value to program management and is well understood by PSE managers and staff. Moreover, PSE's internal adaptive management practices are embedded in program operations and, when needed, prompt, timely mid-course program adjustments occur. Because this 2016-2017 biennium has gone smoothly and without any findings requiring re-estimation of savings, we recommend staying the course with the current BECAR structure for the 2018-2019 biennium.

Recommendation 5: *Continue tracking BECAR report recommendation status. This is standard practice in BECAR and provides continuity between BECAR biennium cycles.*[10]

- **PSE Response:** BECAR report recommendation reviews are being conducted as part of the current 2018-2019 BECAR cycle.
- **Evergreen Assessment:** This recommendation is being addressed and we recommend that this be continued in future BECARs.

Recommendation 6: *Continue conducting UES and supporting documentation reviews. Developing and updating UES values is a complex task and, given the magnitude of savings in the PSE portfolio, justify regular third-party review.*[11]

- **PSE Response:** UES and documentation reviews are being conducted as part of the current 2018-2019 BECAR cycle.
- **Evergreen Assessment:** This recommendation is being addressed and we agree that this process should continue for future BECARs.

Recommendation 7: *Continue evaluation response reviews. Based on review of the ERRs and evaluations for 2016-2017, it is evident that where practical, PSE program staff quickly implement recommendations from the third-party evaluations. For recommendations that are either partially implemented or not implemented, PSE project managers put forth clear reasoning to support their decisions. While some of the evaluation findings have prompted direct actions, PSE's own internal adaptive management process also provides both impetus and solutions to a significant number of the issues raised, frequently in advance of the receipt of evaluation results.*[12]

- **PSE Response:** Evaluation report responses are being conducted as part of the current 2018-2019 BECAR cycle.

[10] Ibid, pg. 28.
[11] Ibid, pg. 28.
[12] Ibid, pg. 29.

- **Evergreen Assessment:** This recommendation is being addressed and we agree with the prior assessment in terms of adding value to the process. We have expanded on this recommendation in the next section to include documenting additional detail on the specific evaluation recommendations so they can be tracked in future BECARS.

2.4 Evaluation Report Response Review

A separate BECAR task involved reviewing the PSE evaluation reports that were completed during the 2018-19 review period and assessing progress made on the recommendations included in each report. The reports included in this review are:

1. 2015-16 Resource Conservation Manager Program Evaluation (June 4, 2018)
2. 2017-18 Multifamily Retrofit Program Evaluation Report (March 15, 2019)
3. 2017-18 Web-Enabled Thermostats Program Impact and Process Evaluation Report (November 20, 2019)
4. 2017-19 Home Energy Assessment Evaluation Program (November 20, 2019)
5. 2017 Home Energy Reports Program Impact Evaluation (April 27, 2018)
6. 2018 Home Energy Reports Program Impact Evaluation (November 15, 2019)

For each evaluation report, PSE provided an Evaluation Report Response (ERR) that identifies the specific actions to be taken to address each recommendation. In some cases, such as with the older evaluation reports, the BECAR team followed up with PSE staff to determine the current status of their response to recommendations.

The detailed recommendations are included verbatim in Appendix A of this report, along with the PSE responses. The status of the recommendation responses are summarized by report below.

2015-16 Resource Conservation Manager (RCM) Program Evaluation (June 4, 2018)

The RCM program is designed to achieve energy savings in commercial buildings through changes in operations and maintenance practices in addition to promoting behavior-based savings. To achieve this, the program provides financial incentives, trainings and other outreach assistance to program participants. In the evaluation, the recommendations were divided into 'considerations' and 'recommendations', and PSE provided responses for both. Several of the recommendations involve technical aspects of how energy impacts are being estimated, which PSE has addressed. Some of the recommendations focused on providing additional trainings and outreach to the RCMs, and PSE tailored their response activities where needed based on the demand from the program participants. In our assessment, PSE is providing a reasonable response to these recommendations, with all recommendations either being addressed or addressed to the extent reasonable given the level of interest by the program participants. Finally, one recommendation highlights the need to test for differences in savings between schools and other government facilities, and

this will need to be addressed in an upcoming evaluation that should be reviewed as part of the next BECAR.

2017-18 Multifamily Retrofit Program Evaluation Report (March 15, 2019)

The Multifamily program is designed to increase the installation of energy efficient measures in existing multifamily buildings (5 units or more). The program provides an energy audit, direct installation of some low-cost measures, and incentives for the installation of more complex measures. In the evaluation report, recommendations were related to program design, program implementation, participation/marketing, and energy savings. For the program design and implementation recommendations, these have largely been addressed by PSE. The energy savings recommendations include a detailed list of specific measure-level savings values that PSE will review and consider adopting as part of its next biennium. The status of that review should be confirmed as part of the next BECAR. Similarly, the report recommends changes to the participant tracking to allow for better follow up with customers, and the status of these changes should be reviewed as part of the next evaluation and the next BECAR.

2017-18 Web-Enabled Thermostats Program Impact and Process Evaluation Report (November 20, 2019)

This program provides a $75 incentive to customers that install an energy efficient smart thermostat. Because this report was finalized near the end of this BECAR review period (November 2019), PSE has not had much time to implement concrete actions in response to recommendations. PSE has provided responses that indicate how they plan to address these recommendations, however, and their responses are reasonable given the current timing. These recommendations should be addressed both in the next evaluation of this program and in the next BECAR review.

2017-19 Home Energy Assessment (HEA) Evaluation Program (November 20, 2019)

The HEA program provides free energy assessments and then provides the homeowner with recommendations for reducing their energy use. In this evaluation, many recommendations focused on specific adjustments to energy savings values, changing the program logic model, fixing some software glitches, and suggestions for creating indicators for tracking program progress. These recommendations have already been largely addressed by PSE. Additional recommendations focus on changes to program implementation such as improving customer outreach and energy specialist training. PSE is in the process of addressing these recommendations, and progress on these should be examined in the next program evaluation and BECAR.

2017 HER Impact Evaluation – Final Report (April 27, 2018) & 2018 HER Impact Evaluation – Final Report (November 15, 2019)

The Home Energy Report (HER) program encourages decreased energy use by providing residential customers with a report comparing their energy use to a matched peer group of similar households. This program was evaluated twice during the BECAR review period,

with the same firm doing the evaluation each time. The recommendations from the first evaluation were all satisfactorily addressed and discussed in the most recent evaluation report. In the most recent report, some of the recommendations relate to how the program is implemented to different customer groups, which PSE has already addressed. Other recommendations relate to how savings are estimated, and these will need to be included in the next evaluation. As with the other evaluations, PSE's progress on addressing these recommendations should be included as part of the next BECAR.

Additional detail on each of the individual evaluation report recommendations, PSE's response, and the BECAR team's assessment of that response is included in *Appendix A* of this report.

2.5 In-depth Review of Selected Energy Savings

For the 2018-2019 BECAR period, no measures or programs were identified by PSE, WUTC, or the CRAG for in-depth review of energy savings, so this optional task was not conducted.

3 Conclusions and Recommendations

Based on the findings of the reviews described above for the 2018-2019 biennium, we have developed a number of conclusions and associated recommendations to improve PSE's energy savings estimates, program management, and evaluation research. These are organized below by BECAR task.

3.1 Unit Energy Savings Review

Overall, we found that the UES values in use by PSE were applied correctly and were based on reasonable assumptions. Specific recommendations were made in an interim memo and PSE has since responded to those recommendations. There are no additional recommendations at this time for updating the measure-specific UES values.

Past BECARs have recommended that PSE improve the documentation for the UES values by creating more straightforward links between the specific measure named in the tracking data and the related business case documentation. PSE has begun the process of improving its tracking systems to link the business case documents to the program tracking data, we recommend that progress on this be assessed as part of an UES review completed as part of the next BECAR.

Recommendation: Include an assessment of the business case documentation links to tracking data as part of the UES review task in the next BECAR.

3.2 Portfolio Savings Audit

The Evergreen team conducted an audit of PSE's portfolio savings as they appeared in the PSE 2018 Annual Report compared to a year-end extract of PSE's tracking data. This process was repeated for 2019 using PSE's tracking data and comparing it against the portfolio savings in the final savings tables that PSE will use in their upcoming 2019 Annual Report. We were able to confirm the total kWh values matched those reported by PSE for both years.

3.3 Previous BECAR Recommendation Response Review

The Evergreen team found that all recommendations made in the 2016-2017 BECAR Final Report have since been addressed or PSE has adequately explained their reasoning for not pursuing follow-up to those recommendations.

The process of documenting and reviewing the BECAR recommendations every two years has resulted in a smoother review process that has consistently improved PSE's savings estimation practices and documentation over time. The result is that there are fewer general BECAR recommendations as the procedures are in good shape. As a result, more of the focus of this BECAR was directed to the evaluation recommendations, which are specific to individual programs.

Recommendation: Continue tracking BECAR recommendations and responses.

3.4 Evaluation Report Response Review

Given the timing of some of the evaluation reports, it is not possible for all of the recommendations to be addressed by the time the current BECAR ended. While PSE has taken reasonable steps to begin addressing all of the evaluation recommendations, the adequacy and effectiveness of their actions may not be known until the next time the program is evaluated. This is especially true for recommendations relating to changing program implementation, which will need to be assessed during the next program evaluation based on customer feedback in order to determine if the initiated actions have been effective. In order that follow up continues for these longer term recommendations, we recommend that they be explicitly tracked as part of each BECAR, with progress assessed once a new evaluation report becomes available. Having future evaluations identify specific research issues that originated from the BECAR process would help with tracking progress in these areas.

Recommendation: Continue with evaluation response tracking and identify longer-term recommendations that should be specifically addressed in future evaluations.

Recommendation: Review the status of longer-term recommendations that were identified in this BECAR that should be addressed in future evaluations, which are summarized in Table 7 (with specific report page numbers included in parenthesis) and copied verbatim in *Appendix A*.

Table 7: 2018-19 Evaluation Recommendations for Future BECAR Review

Program (Evaluation Report Date)	Recommendation (page #)
Resource Conservation Manager Program (June 4, 2018)	Test for savings differences between schools and other government buildings (p. 42)
Multifamily Program (March 15, 2019)	Develop and track HTR indicators for harder to reach MF sub-segments (p. 4 of report w/ PSE ERR) Update gas UES values in 2020 for thermostatic showers and adapters (p. 4 of report w/ PSE ERR) Update window measures savings for gas heated homes (p. 4 of report w/ PSE ERR) Enhance participant data tracking to follow-up with customers and increase conversion to retrofit projects (p. 6 of report w/ PSE ERR) Update savings for specific measures included in table (pp. 7-10 of report w/ PSE ERR)
Web-enabled Thermostat Program (November 20, 2019)	Update deemed savings value for gas customers to 21 therms (p. 4) Conduct additional impact research for electric heating customers using an expanded participant pool and consumption data (pp. 6-7) Conduct additional impact research for gas heating customers using an expanded participant pool and consumption data (pp. 6-7) Evaluate the influence of PSE's efforts to promote 'set it and forget it' message (p. 8) Deliver 'set it and forget it' message on PSE's website via short videos or links to other resources (p. 8) Conduct more research to determine best customer targeting strategies (p. 8)
Home Energy Assessment (November 20, 2019)	Adopt a multi-pronged approach for messaging savings recommendations to customers (p. 14) Improve marketing efforts that encourage word-of-mouth advertising (p. 15) Provide customers more information prior to the assessment (p. 15)
Home Energy Reports Program (November 15, 2019)	Explore claiming savings from move-out homes (p. 31) Examine trend of decreased savings for expansion groups thru a comprehensive review of outcomes/strategies and models (p. 32)

Appendix A:

Detailed Evaluation Report Recommendations, PSE Responses, and BECAR Assessment

This appendix summarizes the evaluation recommendations from the following reports:

1. 2015-16 Resource Conservation Manager Program Evaluation (June 4, 2018)
2. 2017-18 Multifamily Retrofit Program Evaluation Report (March 15, 2019)
3. 2017-18 Web-Enabled Thermostats Program Impact and Process Evaluation Report (November 20, 2019)
4. 2017-19 Home Energy Assessment Evaluation Program (November 20, 2019)
5. 2017 Home Energy Reports Program Impact Evaluation (April 27, 2018)
6. 2018 Home Energy Reports Program Impact Evaluation (November 15, 2019)

Recommendations (and considerations) are listed below by category as they appear in the reports. Some of the PSE responses have been updated based on information obtained from PSE staff as part of the current BECAR review.

2015-16 Resource Conservation Manager Program Evaluation (June 4, 2018)

Note that for this report, Cadmus has provided both 'considerations' and 'recommendations', both of which are provided verbatim below.

Consideration #1: *It is best practice for energy management programs to report negative RCM savings estimates unless omitted variables or other modeling issues can be identified. If there is evidence that either the baseline consumption model is incorrectly specified and cannot be improved or capital project savings are overestimated, Cadmus suggests that PSE report zero savings or declare that the facility is not evaluable. Otherwise, we suggest that PSE report the savings estimate, regardless of the estimate's sign.*

PSE Response: As stated by Cadmus on page 28 of this report, 'Situations in which RCM implementation leads to an increase in energy consumption are expected to occur rarely.' However, in cases where energy use at an RCM site has increased, PSE will document and review information on programmatic and non-programmatic activities that may contribute to the unexpected increase in energy use ("negative savings.") In cases where it is clear that non-program related onsite activities have created a significant increase or decrease in energy use, the baseline may be adjusted accordingly. However, if there is any question about the impact of capital projects, modeling issues, or non-routine adjustments that indicate actual savings may be masked, the site will be excluded from the analysis of program performance for that year.

Evergreen Assessment: PSE is following the proposed approach described in the PSE response above. This appears to be an improvement on the previous approach, and PSE

staff are still engaged in the conversation of how to deal with negative savings estimates for the program.

Consideration #2: *When using monthly billing data to estimate savings, PSE should consider calendarizing billing-cycle HDDs and CDDs. Calendarizing billing-cycle HDDs and CDDs maintains the relationship between energy consumption and weather because both variables are measured over the same period. Currently, PSE calculates monthly HDDs and CDDs by summing degree days for days in each calendar month. PSE may be able to increase the accuracy of its baseline models and savings estimates by calendarizing billing-cycle HDDs and CDDs. At the program level, differences in weather calendarization methods have little impact on savings estimates, because over- or under-estimation of savings for individual facilities appear to cancel out. However, facility level results may be less accurate, as suggested by the lower model adjusted R-square statistics using PSE's calendarization method. These findings are discussed further in the Assessment of Reported Savings Calculation Methodologies section.*

PSE Response: Starting in 2017, PSE started using daily data with correlating HDDs and CDDs to estimate savings wherever possible. This addresses the issue of different methods of calendarization for weather and consumption data. Note that for those sites with only invoice data available, weather data will continue to be calendarized separately from consumption data until a tool is developed that can easily do both for the large number of sites in the program.

Evergreen Assessment: As recommended, PSE has begun using a calendarized approach to calculating HDDs and CDDs for each billing period. Currently, PSE is doing this for as many sites as possible, given the granularity of data available, and expects to be able to expand this approach to additional sites as more AMI meters are installed at customer sites.

Consideration #3: *PSE should consider improving its selection of HDD and CDD base temperatures. Currently, PSE selects base temperatures using its knowledge of facilities and information about thermostat settings from RCMs. Cadmus suggests PSE look for data-driven methods of selecting base temperatures, including the method Cadmus used. This method selects the best CDD and HDD base temperature pairs by testing pairs of CDDs and HDDs using different base temperatures ranging between 45°F and 85°F and selecting the pair that maximizes the model adjusted R2. Cadmus consistently selected lower base temperatures for both HDD and CDD. On average, we selected CDD base temperatures 8.5 and 4.4 degrees lower than PSE for electric and natural gas models, respectively. For natural gas models, Cadmus selected average HDD base temperatures 6.6 degrees lower than PSE. PSE may consider a different range of acceptable base temperatures based on its knowledge of facilities, but it should consider that true set points may differ from (and tend to be lower than) what RCMs report.*

PSE Response: Starting in 2017, PSE began to vary the base temperatures for the determination of HDDs and CDDs for those sites with daily data available. As of 2018, PSE will do the same for those sites with only invoice data. In those cases where a different

base temperature results in a better model fit, the base temperature will be adjusted and the optimized temperature documented.

Evergreen Assessment: Evergreen Assessment: This recommendation has been addressed and PSE is now varying the base temperatures for calculating HDDs and CDDs for all sites.

Consideration #4: *As PSE rebrands the RCM program, it should highlight the program's hands-on technical assistance and ensure that the program is adequately staffed and resourced to continue this level of support. Energy management programs often involve close working relationships between utility staff and customers to implement energy efficiency projects. PSE should consider adding staff to the program to maintain the current level of support.*

PSE Response: PSE will continue to balance the needs of RCM (CSEM) customers with the budgetary decisions necessary to ensure the cost effectiveness of the program. Additional engineers in Business Energy Management are currently being trained to reduce the load on RCM (CSEM) team members and leave them more time for customer support.

Evergreen Assessment: PSE has been focused on the availability of technical assistance to customers, both by increasing customers' access to technical resources at PSE and other external resources like NEEC for Building Operator Certification (BOC) and NEEA's SEMHub. PSE tries to utilize all resources to highlight the technical assistance that is available to customers.

Consideration #5: *PSE should investigate potential improvements to the program in these areas. PSE has already simplified the reporting requirements, but it may be possible to simplify them further without hindering PSE's ability to collect data for measurement and verification. For example, consider consolidating parameter and performance metrics on a single page. PSE should also consider increasing the frequency of MyDataManager trainings, providing "office hours" for RCMs who are struggling with the software, and using email blasts to highlight the software's features.*

PSE Response: PSE is exploring additional options for customer reporting including sending out a quarterly report highlighting the sites with the most and least savings as a prompt to customers, asking customers to send in "hit lists" instead of site quarterly checklists, and asking for frequent feedback on reporting requirements. PSE offered weekly office hours on MyDataManager in 2017, but stopped due to a lack of interest. PSE will restart these office hours as a once/month meeting and continue to hold annual MyDataManager in-person training.

Evergreen Assessment: PSE noted that there has not been much attendance at monthly office hours that have been offered to assist customers with their questions, so they primarily answer customer questions as they come in and have a dedicated staff person for that. In terms of simplifying the reporting process, PSE is trying a new approach in

2019 where the request for customer reports will be sent as a survey for participants to complete. This is an effort to make the reporting process easier for participants.

Consideration #6: *PSE should consider developing basic training modules and an online library of trainings. Developing basic training modules would ensure that new RCMs have a basic level of knowledge. Also, PSE should consider building an online library of webinars to deliver training modules for common O&M issues. PSE could conduct a brief survey of RCMs to identify a list of most-pressing training needs.*

PSE Response: In February of 2018, PSE rolled out a PSE-specific portion of NEEA's SEMHub. This platform provides on-line learning tools and allows PSE to set curricula for existing and new customers. This platform will also contain recordings of PSE webinars. Trainings will continue to be set based on an annual survey sent out to participating customers to identify the most pressing training needs.

Evergreen Assessment: PSE directs customers to the online trainings available at NEEA's SEMHub, and they continue to add trainings to that site. PSE has also continued their annual customer survey to gather feedback on training resources to help identify future training needs.

Recommendation #1: *PSE should continue to promote energy efficiency capital projects at RCM facilities. Although other PSE energy efficiency programs take credit for energy savings from incentivized capital projects in RCM participant facilities, PSE should continue to promote them to RCM program participants. RCMs reported that the program's technical assistance was important in the decision to implement many capital projects.*

PSE Response: PSE will continue to promote a holistic approach to energy management for its RCM/CSEM customers. This holistic approach includes O&M improvements, behavior change campaigns, and capital projects that reduce energy use. PSE's financial incentive structure and communication with customers will continue to support all of these approaches.

Evergreen Assessment: It is still PSE's practice to promote capital projects to customers as part of the overall approach to this program. PSE is taking a reasonable approach to addressing this recommendation, given the multiple factors beyond energy efficiency that influence capital project decisions.

Recommendation #2*: PSE should collect and incorporate data on facility closures – schools, in particular – into its baseline models. Cadmus found that the accuracy and predictive ability of its baseline regression models often improved when the number of facility closure days was included as an explanatory variable. PSE is in the process of making this enhancement.*

PSE Response: In 2017, PSE started using an on-line analysis tool that incorporates site occupied hours information into the baseline models. Wherever possible, PSE will

continue to use occupied hours as an explanatory variable when calculating predicted energy consumption.

Evergreen Assessment: PSE has been incorporating information on site occupied hours into their savings estimation models. This, along with increased availability of AMI data, has improved the accuracy of savings estimates.

Recommendation #3: *The next evaluation should test more definitively for differences in savings between government facilities and schools. This can be accomplished by significantly increasing the number of sampled government buildings and maintaining or increasing the number of sampled schools. PSE should sample enough facilities of each type to detect a hypothesized difference in savings (e.g., 2%) with 80% or 90% likelihood (the statistical power of the test). If significant differences are found, PSE may be able to direct more program marketing resources to increasing the enrollment of government facilities or making changes to RCM program implementation to increase savings in schools.*

PSE Response: PSE is in the process of starting an evaluation of the program, and this recommendation is to be executed.

Evergreen Assessment: PSE is in the process of addressing this recommendation, and the next evaluation should be reviewed as part of the next BECAR to confirm that this issue was addressed.

Recommendation #4: *Assist school RCMs in outreach about energy efficiency to teachers, administrators, and students. At the RCM annual meeting, schools RCMs shared challenges with implementing O&M and BB measures and requested training from PSE about how to engage building occupants in energy efficiency efforts.*

PSE Response: PSE has developed and launched a CSEM seasonal campaign for customers' energy champions. Every month PSE organizes a webinar with facility managers to promote a specific O&M savings activity that is appropriate for the season. Following the webinar, BEM sends to the customer the specific campaign material both physically and digitally. It includes talking cards for the maintenance staff to discuss the specific topic (e.g., optimum start/stop, freeze protection strategy, reducing solar gain), email templates for the facility manager to introduce the EE campaign topic to the maintenance staff, and action items we recommend.

Evergreen Assessment: This recommendation has been addressed.

Recommendation #6: *PSE should continue to use the three-year measure life estimate from the previous evaluation. The three-year estimate is based on a bottom-up analysis of measure life of individual measures adopted by RCM participants. Although an estimate of measure life based on billing analysis would be preferable, the bottom up analysis is defensible and can serve as a placeholder until a more rigorous billing analysis can be performed. PSE should look for opportunities to estimate measure life based on billing analysis.*

PSE Response: PSE will continue to use the three-year measure life until another estimate based on billing analysis of continuing and leaving RCM/CSEM customers is available to distinguish the measure life of these two different groups.

Evergreen Assessment: We believe that PSE's approach for this recommendation is reasonable.

Recommendation #7: *PSE should communicate program improvements to RCMs multiple times and through several channels, including program newsletters, annual incentive payment reports, and the RCM Annual Meeting.*

PSE Response: PSE held trainings on behavior-based energy savings in 2016, 2017, and plans to do so in 2018. Additionally, they have provided:

- Quarterly check-ins with designated PSE point of contact
- Quarterly emails with program updates
- Annual customer meeting with PSE point of contact, RCM, and others on customer team
- RCM Annual Meeting

Evergreen Assessment: This recommendation has been addressed. PSE does appear to be disseminating program information to participants through multiple channels. In addition to the methods listed above, PSE reports that they have also been sending more frequent emails to customers with program updates and they have several engineers on staff with assigned customers whom they check in with frequently.

Recommendation #8: *PSE should consider sponsoring trainings about implementing behavior-based measures. This training could incorporate content about the psychology of behavior change as well as offer strategies and supporting materials for RCMs to utilize.*

PSE Response: PSE held trainings on behavior-based energy savings in 2016, 2017, and plans to do so in 2018. Additionally, they have provided:

- 2016 – Innovations in Occupant Engagement 6
- 2017 – Social Marketing/Behavior Change
- 2018 – Communicating Up and Down

We will continue to hold trainings on this topic annually as long as customers express interest. We will also identify on-line options and include them on the PSE portion of the SEMHub.

Evergreen Assessment: This recommendation has been addressed.

Recommendation #9: *PSE should develop case studies to highlight the value of energy efficiency and successes of the RCM program. The case studies should demonstrate how the RCM program helped organizations overcome barriers to implementing energy efficiency projects and build a business case for making energy efficiency improvements.*

PSE Response: PSE developed a program brochure that highlights participant successes. Furthermore, PSE encourages customers to share news articles about the success story of their CSEM program. Three customers already shared these stories, which PSE uses to attract new customers in the program.

Evergreen Assessment: We believe that PSE's approach for this recommendation is reasonable.

2017-18 Multifamily Retrofit Program Evaluation Report (March 15, 2019)

Program Design

Recommendation #1: *We recommend PSE update its Program Theory and Logic Model (PTLM) to include additional barriers faced by property managers that hinder their participation in the program, include documentation methods, and add "booster" efforts as a strategy to bolster energy savings garnered by the program.*

PSE Response: PSE has revised the PTLM to reflect the program as operated during the 2017-18 evaluation study period.

Evergreen Assessment: This issue has been addressed.

Recommendation #2: *With respect to KPIs, the evaluation team recommends improved data collection practices and tracking to help the program monitor its own KPIs moving forward. Improved data collection practices include assigning identifiers that both PSE and its implementer use to simplify the process of tracking properties as they progress through the program and ensuring that program tracking data includes full details of where rebated measures are installed, including unit numbers, to avoid records that appear duplicative in the MFRT program tracking data. We also recommend PSE implement a regularly scheduled customer survey and data tracking enhancements to allow for internal tracking of KPIs during implementation.*

PSE Response:

- PSE will assign identifiers to simplify tracking properties as they progress through the program. In 2018 the program added project phase to their project tracking system.
- PSE will ensure that program tracking data includes full details of where rebated measures are installed. The program has implemented the additional fields to capture building numbers and apartment numbers when projects have multiple phases.
- PSE will schedule regular customer survey and data tracking enhancements to allow for internal tracking of KPIs during implementation. As of 2019, the program is tracking seven KPIs and will be doing the following to track these KPIs:

- Ensure 85% of customer survey results are at least "Excellent" or "Good" overall and follow up with any negative reviews; checked weekly.
- Log all complaints and resolve within 3 business days; reviewed quarterly.
- Maintain 85% or better DBTC ratio (incentive payments / admin costs) for electric projects; reviewed quarterly.
- Maintain 80% or better DBTC ratio (incentive payments / admin costs) for gas projects; reviewed quarterly.
- Maintain average of less than 14 days to review completed pre-approval applications; reviewed monthly.
- Maintain average payment approval processing time less than 7 business days; reviewed monthly.
- Verification appointments and mid-point inspections scheduled within 7 business days; reviewed monthly.

Evergreen Assessment: This issue has been addressed.

Recommendation #3: *We recommend PSE develop and track a hard-to-reach KPI based on efforts to define and target sub-segments of the MF market that may be harder-to-reach than others. To accomplish this, we recommend that PSE use the GIS tool described above to target customers that align with the BCP's overarching goals related to targeting HTR segments. We also recommend that PSE develop additional KPIs to assess progress toward program goal of increasing participation within HTR segments of the MF market.*

PSE Response: The Multifamily program has recently leveraged purchased real estate data sets from CoStar, which identifies smaller independent owners of one or two properties. This subgroup of MF property owners have not yet completed upgrades, however we have successfully engaged with many of these sites through new outreach strategies. As identified in the 7th Power Plan, Multifamily is a HTR group in of itself, and we continue to promote the program throughout our service area. Additionally, PSE has specifically coordinated projects with Tribal stakeholder groups. Geographic and English as a second language demographics are also areas being used for additional identification and outreach.

Evergreen Assessment: PSE is in the process of addressing this recommendation, and progress on these KPI's should be assessed as part of the next evaluation of this program.

Program Implementation

Recommendation #4: *The RTF (v2.1) does provide electric savings but does not provide gas savings for thermostatic showerheads and adapters. To address this, PSE staff converted the RTF kWh values for "any" water heating fuel type when the tracking database indicates gas water heater. PSE should update the gas deemed savings value such that it converts the RTF deemed kWh savings for "electric" waters to therms instead of the RTF kWh savings for "any" water heater type. PSE should track the electric heating equipment type and apply the appropriate RTF deemed value or apply an average value that appropriately weights the RTF deemed savings for all heating*

equipment types going forward. The deemed savings value that PSE applies in 2017 is appropriate given the electric heating equipment is unknown.

PSE Response: PSE updated gas UES values for 2019 to reflect RTF therms saved as identified on the "measure Input/output" calculations of v2.0 (workbook v2.1 was not available prior to the Sept 1st 2018 cutoff). PSE will update these values again for 2020 according to v3.0 or the current workbook available before Sept 1st 2019.

Evergreen Assessment: PSE is in the process of addressing this recommendation, and the next evaluation or BECAR should confirm that these values have been updated for 2020.

Recommendation #5: *Because the heating equipment type is not tracked in 2017, PSE should convert the RTF electric savings for forced air furnaces (FAFs) to therms and apply the converted value retrospectively. The RBSA supports that the majority of gas heated apartments use FAFs. For future program years, PSE should track the gas heating equipment type and convert the appropriate RTF electric deemed value to therms.*

Updated PSE Response: Program staff updated insulation measures for gas heated dwellings using eFAF as the basis for converting to therms. PSE plans to incorporate this conversion for window measures for gas heated homes once the RTF publishes an updated Multifamily Weatherization workbook. The conversion currently in place for these two measures remains conservative which resulted in an under calculation of savings by 330 therms in 2019.

Evergreen Assessment: PSE is in the process of addressing this recommendation, and the progress on this issue should be examined as part of the next evaluation and after the RTF updates the Multifamily Weatherization workbook.

Recommendation #6: *The RTF does not provide a deemed savings values for R-11 to R-38 for attic insulation. It instead includes deemed values for R-0 to R-38 and R-19 to R-38. We recommend updating deemed savings by calculating the average savings per R-value (kWh/R-value) using the RTF deemed savings values and multiplying it by the increase in R-value from R-11 to R-38.*

PSE Response: Staff from the RTF developed a PSE deemed measure workbook for R11-38 using the same methodology and SEEM modeling software as the R0-38 and R19-38 attic insulation measures. Given the R-values do not exhibit a linear relationship with savings, we believe the RTF SEEM model provides the greatest accuracy for the R11-38 attic insulation measure.

Evergreen Assessment: This recommendation has been addressed.

Recommendation #7: *Although participants are overall satisfied with the DI measures offered though the program, the evaluation team recommends incorporating participant feedback on potential product improvements to further boost product satisfaction. Specifically, the evaluation*

team recommends considering offering LED bulbs with varying levels of brightness, providing more detailed instructions (or maybe hands-on demonstrations) of how to use showerhead adapters, and making sure that to the greatest extent practicable, DI products are installed and not left behind for tenants to install themselves.

PSE Response: Residential surveys have increased fourfold since 2017. These surveys are provided after each direct install appointment and that program is currently on hold due to COVID-19. The program is evaluating a new engagement strategy to minimize person-to-person contact, which will likely include email surveys sent to each participant. As for recommendation to provide varying levels of LED bulbs or water fixtures, the program now provides these upon request. Senior housing facilities have typically requested bulbs with higher color temperature, and some sites have requested 1.0 gpm aerators rather than 1.5 gpm.

Evergreen Assessment: This recommendation is being adequately addressed.

Participation & Marketing Recommendations

Recommendation #8: *To attract more HOA or condominium-style MF properties, we recommend targeting HOA customers with different activities and participation requirements. A significantly higher percentage of full participants, those who installed deeper energy saving measures with the help of program rebates, were HOA or condominium-affiliated, compared to stalled participants, or those participants who do not go beyond the free components of the program (15% versus 3%). The HOAs tend to go deeper into the program when they participate, but do not currently represent a large portion of the participating properties. Many HOAs face larger participation barriers since currently HOA presidents must recruit, organize and schedule all unit-owners to participate at the same time. PSE should consider ways to target the HOA segment differently such as allowing a partial number or percentage of units to participate at a time and/or recruiting HOA properties by taking advantage of the concentration of HOA members at HOA meetings (or similar condo association events) to present the program and offer on-the-spot sign ups.*

PSE Response: The program has recently taken various tactics to engage the condominium segment, including developing and distributing condo-specific literature and adding a scheduling tool that identifies the optimal time for visiting individual condominium units at a given condominium complex. This is because unlike apartment complexes, program representatives need the permission of the condominium unit owner and resident before entering that unit. So essentially, condominium owners need to opt in and be home during the appointment.

Evergreen Assessment: PSE is taking a reasonable approach to addressing this recommendation.

Recommendation #9: *To attract more participants to the program in general, emphasize self-reported program benefits in marketing communications. Stalled participants were also more likely than full participants to cite 'upfront cost' of the equipment as the main factor considered when*

making purchasing decisions (70% versus 44%). Conversely, full participants had a significantly higher proportion of participants selecting 'energy cost to operate' as the main factor considered (19% versus 4%). This suggests that stalled participants tend to have a shorter-term decision calculus whereas full participants may be more likely to consider the longer-term costs. A majority of both stalled and full participants cited reduced utility costs as a top benefit they noticed since their property's participation in the program. PSE should emphasize the most salient benefits participants report seeing from the program (e.g., reduced utility bills and return on investment over time).

PSE Response: The program has begun incorporating additional utility benefits for energy and dollar savings per measure. The Summary of Eligibility provided after an Energy Assessment now provides energy and dollar saving estimates for recommended upgrades.

Evergreen Assessment: This recommendation is being addressed.

Recommendation #10: *To increase conversion to retrofit projects, enhance participant data tracking and use information to follow-up with customers over time. As discussed in the table above, the gap between stalled and full participants may not be that large but better data tracking is needed to track a conversion rate over time to determine the baseline conversion rate and then monitor changes to the rate based on various efforts to increase it. Amongst the few participants that were surveyed who had no plans to install the recommended retrofit upgrades (n=7), four said they would need additional rebate eligibility information to perform the upgrades. Although just four participants are included in the previous example, their responses are illustrative of a larger theme seen in survey and site visit feedback concerning the need for more information and better follow-up.*

The ability to easily follow up and check in with participants at varying stages in the program is incredibly important because it enables PSE and/or implementer staff to maintain the property-level relationships necessary for getting participants to move beyond the no-cost components of the MFRT program. To this end, the evaluation team recommends using enhanced data tracking procedures to uniquely identify a site and maintain that unique designation (and associated contact information) across varying program and implementer databases. This would to allow PSE staff to trace participants' journeys through each of the program components and to designate phased 'check-ins' with those participants who stay in audit-only or DI-only phases for too long without follow-up.

PSE Response: To track conversion rate over time, PSE program staff is compiling a program activity report spanning multiple years. Program staff has also implemented more detailed aging reports for the program vendor to use in follow-up of both audits and PSE approved incentive applications. The program team has recently made their call log available for better visibility to track projects and overall call statistics. Additionally, the program staff reviews customer surveys and responds to customer questions on other rebates, and feedback on the program. The program vendor is reviewing stalled participant data to identify opportunities for follow-up marketing. Stalled project preapprovals are now being flagged for follow-up.

Evergreen Assessment: PSE is taking reasonable steps to address this recommendation, and progress in this area should be reviewed as part of the next evaluation of this program.

Energy Saving Recommendations

Recommendation #11: *Multiple recommendations are provided in a large table on pages 7-10 of the evaluation report that includes the PSE ERRs. This table summarizes specific changes that should be made to savings calculations for measures included in the program. These measures include LEDs, aerators, thermostatic radiator valve (TRV) adapters, showerheads, water heater pipe insulation, clothes washers, heat pumps, furnaces, boilers, heat pump water heaters, and insulation. The recommendations are provided throughout the evaluation report but are summarized concisely by PSE in their ERR on pages 7-10 at the beginning of the report.*

PSE Response: PSE will consider each of the measure recommendations below and incorporate savings updates as needed during 2020-21 biennial planning.

Evergreen Assessment: We believe that PSE's approach for this recommendation is reasonable, and the degree to which these specific changes have been adopted should be reviewed as part of the next BECAR covering the 2020-21 period.

Web-Enabled Thermostats Program Impact and Process Evaluation Report (November 20, 2019)

Gas Savings

Recommendation #1: *We recommend that* ***PSE update the deemed savings assumption for gas heating customers*** *to 21 therms per participant.*

PSE Response: PSE received the evaluation after their internal September 1 cut date for updating measures. PSE will use the most current data when updating measure savings for the 2021 program year.

Evergreen Assessment: PSE is in the process of adopting this recommendation, and the next BECAR should confirm that this deemed savings value has been adopted for 2021.

Recommendation #2: *We recommend that PSE* ***apply the 21 therms savings estimate to each thermostat*** *in the tracking data.*

PSE Response: PSE does not retroactively adjust savings values for measures.

Evergreen Assessment: This recommendation has not been adopted, and PSE's response is reasonable. As noted above, PSE is planning to adopt this deemed value for 2021 savings.

Electric Savings

Recommendation #3: *We recommend that* ***PSE continue to use the latest approved RTF electric deemed savings values*** *until further research can better explore the level of savings from PSE's program specifically.*

PSE Response: PSE agrees. The latest savings values in the RTF workbook were used to calculate electric savings for the measure in 2019.

Evergreen Assessment: This recommendation has been addressed.

Recommendation #4: *We recommend that PSE* ***conduct additional research with an expanded participant pool and consumption data*** *to understand the range of savings and types of electric heating customers who benefit the most from installing thermostats. Options include:*

- ***Expand energy savings analysis efforts to include 2018 participants, and ideally some early 2019 participants****. The evaluation team was unable to include these participant groups given the timing of the evaluation. By spring 2020, PSE should have access to one year of post-participation consumption data for all 2018 participants, and potentially some of the early 2019 participants.*
- ***Use multi-level modeling to generate pooled and individual savings estimates and correlate savings with existing customer data sources****. This will allow PSE to group participants by savings level (i.e., very positive, positive, neutral, negative, very negative) and run a variety of descriptive statistics based on PSE data fields and secondary data sources such as Census or Experian (e.g., program year, device type, housing type) to identify trends associated with savings levels.*
- ***Correlate savings further with data collected via survey efforts.*** *The amount of 2017 electric heating customers and survey responses in this evaluation were too small to draw meaningful conclusions on the range of savings at the household level and correlate that variation with survey data. While the evaluation team conducted a preliminary correlation analysis with gas model participants (see the next section), this was limited to 2017 gas heating participants due to sample constraints. As such, PSE should* ***consider fielding the survey to more 2018 electric heating customers*** *to allow for correlation with electric savings at the household level.*

PSE Response: Based on the findings from this study and the Multifamily Thermostat pilot, PSE is now educating web-enabled thermostat customers on operating the thermostats to save energy and money. In 2020, PSE is also a partner in a NEEA study to identify Smart Thermostat savings. PSE will provide 2018-2019 data for this study.

Evergreen Assessment: PSE has taken some steps to address this recommendation by partnering with the NEEA study. However, the next PSE evaluation of this program should take into account the specific steps listed above to utilize a larger group of participants and more consumption data.

Recommendation #5: *We recommend that PSE conduct the same research for gas customers as well, to better understand how to maximize the potential for gas savings.*

PSE Response: PSE is open to using the recommended evaluation approach for gas saving analysis as well.

Evergreen Assessment: PSE has not yet taken any concrete steps to address this recommendation; it should be addressed in the next evaluation of this program.

Thermostat Engagement

Recommendation #6: *We recommend using marketing collateral or other educational resources (e.g., webinars) to* ***educate customers on the benefits of "setting and forgetting" smart thermostats****. The participant survey specifically found that 93% of respondents adjusted thermostat settings manually for comfort, while 61% considered energy usage. Providing education on how smart thermostats use pre-cooling/pre-heating and other features to manage comfort while optimizing energy efficiency may be helpful in avoiding unnecessary manual overrides.*

PSE Response: PSE plans to incorporate "set it and forget it" themed messaging into their 2020 program marketing.

Evergreen Assessment: PSE is in the process of addressing this recommendation, and progress on this should be examined as part of the next evaluation.

Recommendation #7: *We recommend delivering this information via* ***short videos or links to online resources on the PSE website****. According to the participant survey, almost half of the participants (40%) reported interest in more information. These customers* ***typically preferred to receive information from the PSE website****, rather than in-person coaching or a phone call.*

PSE Response: PSE will take ODC's suggestions into consideration when delivering engaging materials and other marketing tools to help educate customers about their smart thermostats.

Evergreen Assessment: PSE has not yet taken any concrete steps to address this recommendation; progress in this area should be addressed as part of the next evaluation of this program.

Design and Implementation

Recommendation #8: *We do not recommend a program design change at this time. However, in the next biennium as PSE waits for additional analysis into savings they should continue to shift away from seeing smart thermostats as a "plug and play" measure that can save energy for all customers. As discussed above, it is possible that the lack of electric savings found so far is due to a combination of factors such as customer behavior, household characteristics, heating and cooling system characteristics, baseline usage, or the smart thermostat technology itself. The "bring your own thermostat" model currently employed by the program does not easily allow PSE to target certain participant types, beyond potentially offering tiers of incentives or using targeted marketing*

strategies. More research is needed to determine the right strategies and types of participants to target, and if a change in design is necessary to support a cost- effective program.

PSE Response: PSE is in the process of testing different strategies to effectively market smart thermostats to customers. In addition to retail, there is an active pilot for a manufactured homes assisted install program and plans to expand to direct installation.

Evergreen Assessment: PSE is beginning to address this recommendation, and the specific steps taken and their effectiveness should be addressed in the next evaluation.

2017-19 Home Energy Assessment Evaluation Program (November 20, 2019)

Deemed Savings Values for Direct Install and Leave-Behind Measures

Recommendation #1: PSE converts electric showerhead savings to gas with embedded waste-water reduction savings. *The RTF does not provide gas savings; therefore, PSE converted the kWh savings for showerheads to therms for those with gas water heating. However, the kWh savings from the RTF embeds additional savings from waste-water reduction. We recommend removing the additional waste-water savings prior to converting from electric to therm savings. Though this will reduce the deemed gas savings for this measure, it provides a more accurate estimate of savings. The waste-water savings for showerheads with gas water heating are counted toward electric savings as these savings are due to a decrease in pump energy consumption.*

PSE Response: This recommendation has been incorporated into the most recent HEA measure class update.

Evergreen Assessment: This recommendation has been addressed.

Recommendation #2: Not all showerheads in homes with gas water heating were given electric savings toward waste- water. *Waste-water savings are additional savings for showerheads and are embedded in the electric energy savings for homes with electric water heating. However, homes with gas water heating should receive waste-water savings counted toward electric savings. We recommend ensuring that waste- water savings for all homes receiving showerheads with gas water heating receive the additional electric waste-water savings. Making this change led to an increase in reported electric savings.*

PSE Response: In 2020, we will not be claiming any electric savings for showerheads installed in homes with gas water heating. The administrative costs to administer this small savings, was not worth the benefit.

Evergreen Assessment: This recommendation has not been addressed, but the reason given by PSE is appropriate.

Recommendation #3: When the program is no longer able to claim lighting savings, it will greatly reduce the energy savings directly from HEA. *However, HEA will still have an opportunity to contribute savings to the portfolio overall through a number of options including: (1) enhancing efforts to refer more customers to other program opportunities (2) adding different DI and leave-behind measures; and (3) finding ways to boost and measure behavioral savings.*

PSE Response: We will continue to use HEA to refer customers to other program opportunities, and in 2020 will be allocating some of the marketing budget for other programs into HEA's budget. Regarding in-home measures, we will no longer be doing leave behind, only direct install. This should lead to higher persistence and realization rates, as well as potentially better customer satisfaction. We will also be adding water heater pipe wrap to the measures that we install during HEA. Finally, we will be undergoing a pilot in 2020/2021 to investigate non-DI savings associated with additional in-home assessment "energy actions."

Evergreen Assessment: PSE is in the process of responding to this recommendation with reasonable program actions.

Recommendation #4: Per referrals to other programs, more efforts to follow-up with participants on recommendations could further boost savings in the portfolio. *One of the common recommendations for program improvement that participants mentioned was to provide follow-up from PSE or the energy specialists to remind them about the energy saving recommendations and to answer further questions about upgrade costs/rebates. Further, portfolio and HEA-specific energy savings would likely improve if PSE upgraded program technological equipment. Energy specialists reported both hardware and software issues that led to difficulties in providing customers with smooth assessment experiences and complete lists of recommendations.*

PSE Response: In 2020, PSE is launching a Behavioral Pilot to investigate additional behavioral savings associated with the HEA program. That effort will feature a "nurturing" campaign managed by the HEA vendor and will prompt the participant with additional energy savings recommendations via email and phone conversations. PSE will evaluate customer engagement through a follow-up survey and study completed by an evaluator.

To address software issues reported by Energy Specialists, in early 2019, the HEA vendor completed a software refresh and update problematic hardware. Additionally, in late 2019, PSE launched a new referral portal, which features a customer look-up feature to speed the customer referral process.

Evergreen Assessment: This recommendation is being addressed.

Recommendation #5: Per DI measures, PSE should consider the energy saving potential from adding measures such as pipe wrap or water heating blankets to those with electric water heating or "light touch" weatherization measures such as air sealing or attic-hatch

insulation.

PSE Response: Pipe wrap is being added to the HEA measure mix. Other measures are not considered feasible at this time. We considered the idea of "light touch" weatherization, but determined that it would add too much time to the assessment to maintain program cost-effectiveness. However, we will consider using "light touch" weatherization, water heating blankets, and attic-hatch insulation as follow-on nurturing recommendations.

Evergreen Assessment: PSE is conducting a reasonable response to this recommendation.

Recommendation #6: Behavioral savings is a more challenging one to address and may require a multi-pronged approach. *While 88% recall receiving any energy saving recommendations, 54% recalled recommendations to change air filters and 50% recalled recommendations to turn off lights when not in use. The majority of participants did not recall receiving any of the other 20 behavioral recommendations provided. Some participants additionally reported not recalling the recommendations due to the overwhelming amount of information given during the assessment itself. Responding to these suggestions by providing follow-ups should increase engagement with the participants and may increase the program's behavioral saving potential if the potential is there. While this evaluation did not detect any via consumption analysis, it is possible the behavioral savings are too small to pick up in the statistical model and other engineering-based approaches can measure those savings. Regardless of method, it is also possible that the baseline consumption of participants is not high enough, on average, to capture behavioral savings. The evaluation conducted the same analytical approach for the evaluation of a similar program in another jurisdiction and found substantial behavioral savings beyond DI measures, however one major difference was the baseline consumption level of participants in comparison to PSE's program.*

PSE Response: As mentioned above, PSE is launching a nurturing campaign in 2020, which will incorporate the recommendations discussed above.

Evergreen Assessment: PSE is in the process of responding to this recommendation; the effectiveness of its actions should be investigated as part of the next evaluation.

Increasing Program Participation and Setting Customer Expectations

Recommendation #7: PSE could improve marketing efforts that encourage word-of-mouth advertising. *Initial HEA marketing had the greatest success through email. The evaluation team found that most participants first heard about the program through PSE's emails, and through previous participant word-of-mouth. There is currently no system to encourage customer-to-customer referrals even though hearing about the program from friends and family was the second most common way for participants to initially learn about the program. Additionally, since it is the evaluation team's understanding that the program implementer and specialists have not taken much of a role advertising the program, PSE could benefit from allowing the program implementers and specialists to distribute referral cards to participants to spur greater awareness and enrollment in the HEA program.*

PSE Response: We piloted referral cards this year, but did not see much success. In 2020/2021, we are considering transitioning this to a digital referral campaign whereby customers would email or text a digital referral card to friends/family.

Evergreen Assessment: PSE is beginning to respond to this recommendation, and the effectiveness of its actions should be addressed in the next evaluation.

Recommendation #8: Participants should receive additional information leading up to the assessment. *Specialists generally agreed that most customers did not know what to expect from the assessment or expected to receive more from the assessment than could be provided. Though customer satisfaction with the program is high, providing more information prior to participation may improve the process and allow specialists more time to focus on behavioral and subsequent program recommendations.*

PSE Response: PSE has updated its pre-assessment materials (website, emails, brochures, door hangers, forms) to more clearly outline the assessment and manage customer expectations. PSE will work with the vendor to assure pre-assessment communications from them include updated language.

Evergreen Assessment: PSE is beginning to respond to this recommendation, and the effectiveness of its actions should be addressed in the next evaluation.

Specialist Interviews

Recommendation #9: *Technology Use - The program seemed to suffer from several technology problems, however. Specialists reported both hardware and software issues including poor camera quality, short battery life of tablets, limited memory and processing power of tablets, 'glitchy' software, unreliable recommendation list loading and referral page errors. These technological issues lead to difficulties in providing customers with smooth assessment experiences.*

PSE Response: All software (memory, processing, etc.) have been resolved since the program implementer's system upgrade in April. We've spoken with all Energy Specialists and they have been very happy with the improvements including processing speed.

Evergreen Assessment: This recommendation has been addressed.

Recommendation #10: *Regarding hardware concerns, battery life issues are very minimal with improved chargers and settings. We regularly update tablets to newer models. The camera quality of the tablet and flash ability is still lacking but most Specialists use their phone (for high photo quality and better safety.*

Recommendation #11: *The recommendation/rebate list was updated in the summer of 2019. PSE and the implementer will coordinate on updates before annual changes and ad hoc as programs change.*

Recommendation #12: *The referral page/time out errors via pse.com have been resolved with the transition to a new referral platform.*

Recommendation #13: *Report Presentation - The largest factor in customer's willingness to invest in upgrades, according to specialists, depended on finances and the way information was presented in the report. Some customers were open about their inability to afford any upgrades. Therefore, many of the specialists attempted to emphasize the financial benefits of energy efficiency over time (8 out of 10 specialists). Five specialists noted that the report could do more to reinforce these topics so that participation in PSE's programs could improve.*

PSE Response: This result has been brought to the attention of the implementer as a training topic for the energy specialists.

Evergreen Assessment: Recommendations 10-13 are more observations than actual recommendations for program improvement. PSE's responses seem appropriate.

Additional Recommendations – Program Theory

Recommendation #14: *The evaluation team identified the following opportunities for improvement:*

- ***Add barriers to the PTLM:*** *Other residential program PTLMs in PSE's portfolio include a "barriers" row that outlines the key barriers to program participation that the target customers face. In addition to ensuring consistent PTLM design, adding this information provides useful context for the rationale behind program interventions.*
- ***Update language to reflect the new implementation structure****: While the process steps are accurate, the language in the current PTLM appears to be based on past CAN implementation structure. Updating the language in the PTLM to reflect FES' role in the new implementation structure may be beneficial for HEA Specialists during the training process through to program delivery.*
- ***Add a program referral pathway:*** *The third activity from the left in the PTLM includes a bulleted sub-activity related to informing customers about other energy efficiency opportunities. Considering the importance of referring customers to other programs, it is recommended that PSE include the following in the PTLM:*
    - *"Informing customers about other energy efficiency opportunities" as a separate activity;*
    - *"CAN and other program referrals" as an output of this activity;*
    - *"Awareness of other programs" as a short-term outcome; and*
    - *"Participation in other PSE programs" as a long-term outcome.*
- ***Clarify documentation methods:*** *The current PTLM contains a placeholder for "documentation" referring to documents or databases that track program outputs. However, the PTLM does not provide specific information on the form of documentation prepared by program staff. Though not a requirement of PTLMs, should PSE want to incorporate this information, it is beneficial for program staff to describe the databases or documents that it uses to track outputs from the program.*

PSE Response: The PTLM has been updated to incorporate these recommendations.

Evergreen Assessment: This recommendation has been addressed.

Program Improvement Suggestions – Customers

Recommendation #15: *Given that one of the KPIs for the program is customer satisfaction and PSE staff mentioned having an interest in understanding customer expectations about the program, the evaluation team asked participants to directly provide recommendations through the survey. Participants came up with several reoccurring recommendation themes. Some of the common themes are as follows:*

- *Include newer tips/recommendations for energy savings, as the current ones are "common sense".*
- *Provide a specialist follow up after the assessment visit to remind customers about the energy saving recommendations and to answer further questions about upgrade costs/rebates.*
- *Provide more specific details about where the high home-energy usage is actually coming from to make the assessment more meaningful.*
- *Offer more equipment in terms of the quantity of each equipment type and the variety of equipment.*

Participants also answered a question about examples of other equipment PSE could provide through the program to spur further interest. The main equipment types that participants suggested were:

- *Air/furnace filters*
- *Heat Pumps*
- *Insulation*
- *Smart thermostats*
- *Solar panels*

Though not suggested by participants, the evaluation team is familiar with home energy assessment programs offered by other utilities around the country. Lower cost non-lighting measures PSE could also consider include weatherization measures, such as outlet gaskets and weather stripping, pipe wrap/insulation, and/or water heater blankets.

- **PSE Response:** There are a number of changes to HEA in 2020/2021 that address these recommendations. Several energy actions, including those listed below, will be offered in 2020 in addition to the direct install and recommendations that HEA already offers.
  - Water heater turn down
  - Thermostat reprogramming
  - Refrigerator turn down
  - Refrigerator coil cleaning
  - DHP filter cleaning

- HEA energy specialists will be offering the direct install of smart thermostats to customers who are willing to pay a copay.
- We have rebates for heat pumps and insulation that the energy specialists are trained to recommend to eligible customers. Energy specialists can also refer customers to our in- network solar installers.
- A nurturing campaign is being planned for 2020/2021 that will provide reminders to customers of tips and recommendations that we made during the HEA.

Evergreen Assessment: PSE is addressing these recommendations appropriately.

PSE Home Energy Reports Program 2017 Impact Evaluation – Final Report (April 27, 2018)

Legacy – Current Group

Recommendation #1: The legacy current group continued to achieve savings similar to the levels it achieved in previous years. Participant measured savings remained steady compared to the previous year, at 3.1% of annual electric and 1.8% of annual gas consumption.

The treatment group continued to demonstrate higher joint savings than its control counterpart, though between the two groups the difference in rebate program participation was not statistically significant. This suggests that through the installation of higher-impact measures, and/or the cumulative year-on-year savings of previously-installed program measures, legacy treatment households have achieved deeper savings than control households, despite similar rates of participation.

Although HER average credited savings remain steady, total credited savings for this group continue to decline as it continues to lose participants due to move-outs. We recommend that future evaluations continue to track the effect of HERs on credited savings and participation in other PSE energy efficiency programs, and consider ways of sustaining total credited savings from the program.

We also recommend updating the upstream lighting survey to ensure that participation and savings from this program reflect current trends.

Legacy – Suspended Group

Recommendation #2: The legacy suspended group stopped receiving HER reports after two years of being in the program, but it continues to use less electricity and gas than its control counterpart over the years. Seven years after the suspension of HERs for these customers, the legacy suspended treatment group still achieved statistically significant electric and gas savings. Its electric savings, however, were about 30% of the legacy current's savings while its gas savings were 60% of the current group's savings in program year 2017.

We recommend that future evaluations continue to track savings from this group to learn about the persistence of the effect of HER messaging.

Expansion Groups

Recommendation #3: The expansion groups' electric and gas savings trends continue their upward trajectory, like the trend for the legacy group in its early years. Assuming this trend continues, per-household savings among the expansion groups will increase in the coming year.

As with the previous year, electric downstream rebate joint savings were statistically significant for all groups except the electric only group. Gas downstream rebate joint savings were significant for all groups except the non-urban group. Rebate program participation, while higher than the previous program year (at about 5% vs 3% in 2016), is statistically the same for treatment and comparison groups in 2017. Like for the legacy group, HER increased uptake in other rebate programs seems to have ended, although deeper savings for expansion treatment groups endure.

We recommend that future evaluations continue to understand trends in savings associated with participation in HER programs and investigate how HERs change customer participation in other PSE efficiency programs.

Unmatched Group

Recommendation #4: Consistent with our findings from last year, the unmatched electric savings per household were twice as high as the legacy current group's electric savings while its gas savings per household were in line with those of the legacy current group. As we estimated savings using a matched comparison group rather than a randomized control group, we used a conservative ceiling for crediting savings for these households that is based on the legacy current group's savings estimates.

We recommend pursuing further matching exercises for this group in the next program year to ascertain the trend in savings and to determine reasonable consumption reduction that can be attributed to HERs for this group.

Evergreen Assessment: These issues were all researched in the PY2018 HER evaluation, discussed below.

2018 Impact Evaluation – Final Report (PSE Home Energy Reports Program, November 2019)

Legacy – Current Group

Recommendation #1: *Savings as a percentage of consumption for the legacy current group were comparable to program year 2017, as the group achieved 2.8% electric savings and 1.6% gas savings (compare to 3.1% and 1.6% savings for program year 2017, respectively). The stability of these savings per household are a hallmark of a mature program of its kind.*

1. *Look into claiming existing savings from move-out homes in current RCTs. To do so, move-out households remain in the existing model and are included (via dummies) as a second treatment. This result may be more variable as the ongoing consumption will include new homeowners in both the moved-out treatment and control households.*
2. *Track moved-out customers that stay in PSE's service territory. This requires a separate model comparing prior treatment and control customers' post-move consumption at the new house.*

PSE Response: PSE has continued to offer the program to the legacy – current group in 2018, and based on the report findings and recommendations, PSE will also continue offering the program to the legacy – current group in 2020. PSE will consider claiming savings from move-out homes and assess the viability of evaluating energy savings of moved-out customers remaining in PSE territory.

Evergreen Assessment: PSE's response to this recommendation is reasonable, and some of the modeling variations will need to be addressed as part of the next evaluation. The ability to conduct these additional models will also rely on some degree on how well PSE is tracking the moved-out customers.

Legacy – Suspended Group

Recommendation #2: *The legacy suspended group received HER reports between 2008 and 2010 and has not received any reports since 2011. Electric savings for this group were not statistically significant in 2018 marking a second time in the past three years that this has occurred. Per-household electric savings declined by 42% from 2017 to 2018. Our analysis suggest that the legacy suspended group may have exhausted its potential to generate electric savings per household, 8 years after the cessation of HER messaging. We recommend that PSE consider re-subscribing the legacy suspended group to increase savings from the program.*

PSE Response: PSE re-subscribed the suspended group in early 2020.

Evergreen Assessment: This recommendation has been addressed.

Expansion Groups

Recommendation #3: *This is the fourth full year of administering HER reports to three of the expansion groups and third full year for one. All groups continue to generate electric savings although these savings as a percent of baseline consumption were lower in 2018 compared to 2017. Gas savings as a percentage of consumption stayed about the same from 2017 to 2018 for all expansion groups. We expect the expansion groups to continue achieving about 1% of gas savings in future years.*

There was no significant difference in rebate program participation between the treatment and control expansion groups in 2018. Despite this, expansion treatment groups had deeper rebate savings in 2018. Electric downstream rebate joint savings were statistically significant for all expansion groups except the electric only group. Gas downstream rebate joint savings were significant for all groups except the non-urban group.

Since 2018 savings per household were notably lower in 2018 than in 2017, we recommend that next year's evaluation identify whether this is a one-time dip, due to weather variation, or part of a general decline in savings available from these groups. A comprehensive review of outcomes and strategies, including weather-normalized savings models, need to be considered at that time. These trends will reveal if the savings per household for these recent PSE HER groups have reached maturity. Savings trends based on additional year of outcomes will also indicate if the newer expansion groups generate lower savings per household than the long-lived legacy current group. Understanding these trends will be useful when designing and launching future HER programs.

PSE Response: Based on the evaluation recommendation PSE will monitor savings trends based on additional year of outcomes. Understanding these trends will be useful when designing and launching future HER programs.

Evergreen Assessment: PSE is planning to address this recommendation as part of the next evaluation of this program. The next BECAR should review the next evaluation and assess progress on that part of the recommendation involving a comprehensive review of outcomes and strategies, including weather-normalized models.