

Evaluation Report Response

Program:	Multifamily Retrofit
Program Manager:	Mac Snow
Study Report Name:	2017-18 Multifamily Retrofit Program Evaluation Report
Report Date:	March 15, 2019
Evaluation Analyst:	Jim Perich-Anderson
Date of ERR:	March 2019

Evaluation Overview, Key Findings, Recommendations and Program Responses:

Overview:

This evaluation report documents the results of the impact and process evaluation of the PSE 2017-2018 Multifamily Retrofit Program. This program is designed to increase the installation of selected cost-effective energy efficiency measures in existing multifamily buildings with five or more attached dwelling units. It provides free energy audits of multifamily buildings to help building owners, operators, and tenants better understand energy consumption and energy savings opportunities. Depending on the results of the energy audit, the program directly installed no-cost measures (e.g., showerheads and LEDs) as well as provided incentives for more complex upgrades (e.g., windows).

The study's goals were to verify measure installations, quantify program level energy savings, collect feedback from participants, and survey stalled participants, defined as those who went no further in the program than just receiving the energy audit and direct-install (DI) measures. Opinion Dynamics developed the following as part of the process and impact evaluations of the 2017-2018 program:

Impact








- Deemed Savings Review
- Sample Design for Evaluated Savings
- Application of Deemed Savings
- Desk Reviews
- Site Visits

Process

- Participant Depth Interviews During Site Visits
- PSE Program Staff Interviews
- Data Tracking and Materials Review
- KPI Review
- Participant Survey

Key Findings:

The evaluation found that the program is capturing electric savings, garnering persistent savings, and providing excellent customer service. However, the program has struggled to meet its gas savings goals due, in part, to a lack of gas saving opportunities in the marketplace and the limited set of gas measures offered through the program. Additionally, because the Multifamily Retrofit program’s contribution to gas savings for the portfolio is small relative to its contribution to overall electric savings, PSE decided to focus on pushing the program’s electric savings since more measures offered under the program are electric. Program staff made changes in 2018 designed to help the program increase its gas savings in the 2018-2019 biennium. In addition to these changes, program staff should consider a few improvements to better demonstrate the value of the program in the marketplace through better data tracking and collection related to KPIs, as described in Sections 2.2 and 2.3 of this report. Further, improved tracking through the assignment of unique property identifiers will simplify PSE’s follow-up efforts with MF customers to encourage them to go beyond the free audit and free in-unit measures to the deeper energy saving measures.

KPI	Definition	KPI Status	Overall Program Health	KPI Data Source
Electric savings	Amount of MWh savings for 2017	Ex-ante savings met 95% of 2017 goal		Program tracking data and MFRT EES 2017 Savings Reports for Electric and Gas Savings
Gas savings	Amount of therm savings for 2017	Ex-ante savings met 36% of 2017 goal		
Participation	Number of measures installed through the program (known as target units in PSE’s EES Tracking and Forecasting System) in 2017	90% of target units installed		
Persistence Rate	Percentage of measures reported as installed that are verified as installed through site visits	Strong persistence, 94% RR for kWh and 112% for gas		Site visits for 2017 impact evaluation
Conversion Rate	# of audits conducted that went on to receive rebates for deeper retrofits	35% over approximately 16 months		Audit and tracking data
Energy Conservation Awareness	Percentage of participants that increased awareness of EE	55% increased awareness of energy efficiency; recall is low		2018 Evaluation
Customer Satisfaction	Average score on a 1 to 5 scale	4.18 average from 2017-2018 participants		2018 Evaluation

Evaluation Recommendations and Program Responses

The evaluation was looking back at the program as implemented in 2017 and 2018. Several of the report's impact and process recommendations were implemented in the 2018-2019 program cycle. The program team strives to ensure that the program is operating at a high level of efficiency and maximizes all opportunities to improve. Still, there are ample opportunities to improve the customer interactions, track & report savings and program outreach/education. As the team plans the 2020-21 program, we will address the evaluation report's additional recommendations. This section presents the specific recommendations made in the evaluation report, and program responses.

Program Design

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.
 - a. PSE has revised the PTLM to reflect the program as operated during the 2017-18 evaluation study period.
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.
 - a. 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.
 - b. 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.
 - c. 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:
 1. Ensure 85% of customer survey results are at least "Excellent" or "Good" overall and follow up with any negative reviews; checked weekly.
 2. Log all complaints and resolve within 3 business days; reviewed quarterly.
 3. Maintain 85% or better DBTC ratio (incentive payments / admin costs) for electric projects; reviewed quarterly.
 4. Maintain 80% or better DBTC ratio (incentive payments / admin costs) for gas projects; reviewed quarterly.
 5. Maintain average of less than 14 days to review completed pre-approval applications; reviewed monthly.

6. Maintain average payment approval processing time less than 7 business days; reviewed monthly.
 7. Verification appointments and mid-point inspections scheduled within 7 business days; reviewed monthly.
 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.
 - a. PSE is in the process of analyzing participant data to identify possible hard-to-reach subgroups within the residential portfolio. Based on that analysis, PSE will make decisions on KPIs for increasing participation within the residential market.

Program Implementation

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.
 - a. 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.
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.
 - a. PSE will further explore the recommendation to convert FAF savings in the develop of weatherization measures for gas heated homes. PSE will also consider the distribution of gas heating equipment in MF homes and determine if a weighted average is a more accurate alternative to the recommendation.
6. The RTF does not provide a deemed savings values for R11 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.

- a. 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 don't exhibit a linear relationship with savings, we believe the RTF SEEM model provides the greatest accuracy for the R11-38 attic insulation measure.
7. Although participants are overall satisfied with the DI measures offered through 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.
 - a. Program staff will coordinate with PSE Customer Insights staff in the development of a strategy for increasing resident survey participation. The program currently relies on messaging on leave behind printed materials to drive residents to complete surveys. PSE will also consider customizing program offerings at the property level based on occupant characteristics at a given property. PSE will work with property managers to customize offerings appropriate to residents.

Participation & Marketing Recommendations

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.
 - a. 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.

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).
 - a. The program has been cautious around setting the expectation of energy savings or the simple payback of deeper retrofits in a formalized report given the variability in building types. However, staff has on occasion discussed with property owners additional resources from the Department of Energy and other sites that provide payback calculator. Program staff will review potential methods to provide this at a high level consistent among PSE Energy Efficiency programs that also acknowledges savings are estimated and not guaranteed.
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 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.

- a. 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.

Energy Savings Recommendations

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

Measure	Key Findings from 2018	Recommendation for 2019 Planning	Status
LEDs	<ul style="list-style-type: none"> Some variables within the PSE derived calculation rely on the RTF but reference an outdated version (v4.2) 	<ul style="list-style-type: none"> Update RTF dependent assumptions using the most current version of the RTF (v6.1) 	<ul style="list-style-type: none"> RTF workbook v6.1 was made available April 2018 and used for 2019 savings update.
	<ul style="list-style-type: none"> Savings calculations reference electric interactive effects when calculating gas heating penalties. 	<ul style="list-style-type: none"> Revise calculation workbook to reference the gas interactive effect values instead of electric. 	<ul style="list-style-type: none"> PSE will review and update as needed in 2020. The MFR program has been consistent with other PSE residential programs and includes HVAC interaction based on multiple SEEM models conducted by the RTF & Ecotope.
	<ul style="list-style-type: none"> Savings are weighted by existing lamp type using RBSA CFL persistence rates 	<ul style="list-style-type: none"> Consider tracking actual removed lamp type (e.g., incandescent, halogen, CFL) to derive PSE-specific saturation rates 	<ul style="list-style-type: none"> Consistent with other PSE residential programs, PSE plans to continue using RTF values based on available RBSA PSE oversample data to determine persistence rates per lamp type. PSE will balance the recommendation against the administrative burden of capturing this information.
Aerators	<ul style="list-style-type: none"> The RTF recently added aerators to the energy savings library in May 2018 	<ul style="list-style-type: none"> Adopt RTF (v1.1) deemed savings values and assumptions Convert RTF kWh for electric waters to therms for those with gas water heaters Remove embedded installation rate of 90% 	<ul style="list-style-type: none"> PSE is now using the most updated value for aerators. [NOTE: v1.1 was published August 2018 and was not in place prior to Sept 1st, 2017 cut-off for updating measure cases.]
TRV Adapter	<ul style="list-style-type: none"> Savings calculations reference deemed savings values from an older version of the RTF (v1.3) 	<ul style="list-style-type: none"> Update deemed values to those in the most current version of the RTF (v2.0) Convert RTF kWh for electric waters to therms for those with gas water 	<ul style="list-style-type: none"> Values based on an updated measure case will be used in 2019. [NOTE: PSE correctly applied v 1.3 for time period that the evaluation covers. The RTF published v1.3 November 2016 after the Sept 1st

Measure	Key Findings from 2018	Recommendation for 2019 Planning	Status
		heaters	cutoff for use in 2018.
Showerheads	<ul style="list-style-type: none"> Deemed savings from the RTF (v3.1) is for any home type 	<ul style="list-style-type: none"> Apply RTF (V3.1) deemed savings value for MF homes Convert RTF kWh for electric waters to therms for those with gas water heaters 	<ul style="list-style-type: none"> Under consideration for further review
Showerhead w/ TRV	<ul style="list-style-type: none"> Savings calculations reference deemed savings values from an older version of the RTF (v1.3) 	<ul style="list-style-type: none"> Update deemed values to those in the most current version of the RTF (v2.0) Convert RTF kWh for electric waters to therms for those with gas water heaters 	<ul style="list-style-type: none"> Values based on an updated measure case will be used in 2019. [NOTE: PSE correctly applied v 1.3 for time period that the evaluation covers. The RTF published v1.3 November 2016 after the Sept 1st cutoff for use in 2018.
Water Heater Pipe Insulation	<ul style="list-style-type: none"> Deemed savings are no longer supported by the RTF 	<ul style="list-style-type: none"> The RTF site removed all traces of savings for this measure. Update deemed values using other creditable sources 	<ul style="list-style-type: none"> Under consideration for further review. In spite of being a small saver measure, PSE based the savings value on the most recent (2010) RTF value. PSE will conduct research to determine whether an updated savings value is justifiable.
ENERGY STAR Clothes Washer	<ul style="list-style-type: none"> PSE used data from the RTF (v5.4) to calculate an average deemed savings for front loading and top loading clothes washers 	<ul style="list-style-type: none"> Apply the appliance specific deemed savings from the most current version of the RTF (v6.1) when the clothes washer type is known 	<ul style="list-style-type: none"> PSE correctly applied v 5.4 for time period that the evaluation covers. Workbook version v 6.0 was released after the September 1, 2017 for the 2018 measure cases. PSE is applying the appliance specific deemed savings from the most current version of the RTF when the clothes washer type is known.
		<ul style="list-style-type: none"> Consider performing additional research (e.g., collect clothes washer type) to calculate a weighted savings using the appliance specific deemed values in the RTF (v6.1) when the clothes washer type is unknown 	<ul style="list-style-type: none"> Under consideration for 2020 measure case.
Clothes Washer (Common Area)	<ul style="list-style-type: none"> Deemed savings are PSE Derived using multiple sources. 	<ul style="list-style-type: none"> Update deemed values to those in the most current version of the RTF (v5.1) 	<ul style="list-style-type: none"> Current values based on updated measures used in 2019. PSE correctly applied RTF v1.3 for evaluation time period.
Air Source Heat Pump	<ul style="list-style-type: none"> Applied deemed savings from the Dealer Channel Space Heat program 	<ul style="list-style-type: none"> The evaluation team was unable to assess the reasonableness of 	<ul style="list-style-type: none"> Under consideration for 2020 measure case

Measure	Key Findings from 2018	Recommendation for 2019 Planning	Status
		<p>assumptions for this measure and instead compared the deemed savings value to other sources. The savings values align with other sources for single family (SF) applications. To remain consistent with savings calculations for other MFRT HVAC measures, conduct additional research from multiple sources (e.g., RBSA, Residential Energy Consumption Survey or RECS, PSE data, etc.) to determine an adjustment rate to account for MF homes having smaller heating and cooling loads compared to SF and update savings calculations accordingly</p>	
ENERGY STAR Gas Furnace ENERGY STAR Gas Boiler	<ul style="list-style-type: none"> Deemed savings applies a 75% adjustment rate to account for smaller conditioned floor area and heating loads for MF homes. PSE is unable to supply the original source 	<ul style="list-style-type: none"> Conduct additional research (e.g., RBSA, RECS, PSE data, etc.) to compare the applied adjustment rate against MF assumptions from multiple sources and update savings calculations accordingly 	<ul style="list-style-type: none"> Under consideration for 2020 measure case
Heat Pump Water Heater	<ul style="list-style-type: none"> Savings calculations reference deemed savings values from an older version of the RTF (v3.4) 	<ul style="list-style-type: none"> Update deemed values to those in the most current version of the RTF (v4.1) 	<ul style="list-style-type: none"> PSE correctly applied RTF v3.4 for evaluation time period. HPWH measure was updated with RTF v4.1 for 2019.
Heat Pump Water Heater	<ul style="list-style-type: none"> Deemed savings applies an 85% adjustment rate to account for smaller water heating loads for MF homes. PSE is unable to supply the original source 	<ul style="list-style-type: none"> Conduct additional research (e.g., RBSA, RECS, PSE data, etc.) to compare the applied adjustment rate against MF assumptions from multiple sources and update savings calculations accordingly 	<ul style="list-style-type: none"> Under consideration for 2020 measure case
Insulation	<ul style="list-style-type: none"> Deemed savings based on output data from SEEM modeling software 	<ul style="list-style-type: none"> Consider updating deemed savings values to those in the most current version of the RTF (v3.4) to remain consistent with other PSE programs 	<ul style="list-style-type: none"> PSE correctly applied the available RTF values for evaluation time period, and RTF v3.4 was used for 2019. Further review will be made for 2020 measure planning.

Measure	Key Findings from 2018	Recommendation for 2019 Planning	Status
		<ul style="list-style-type: none"> ▪ Apply RTF deemed values for zonal heating for electric savings and convert RTF deemed values for FAF for gas savings. 	

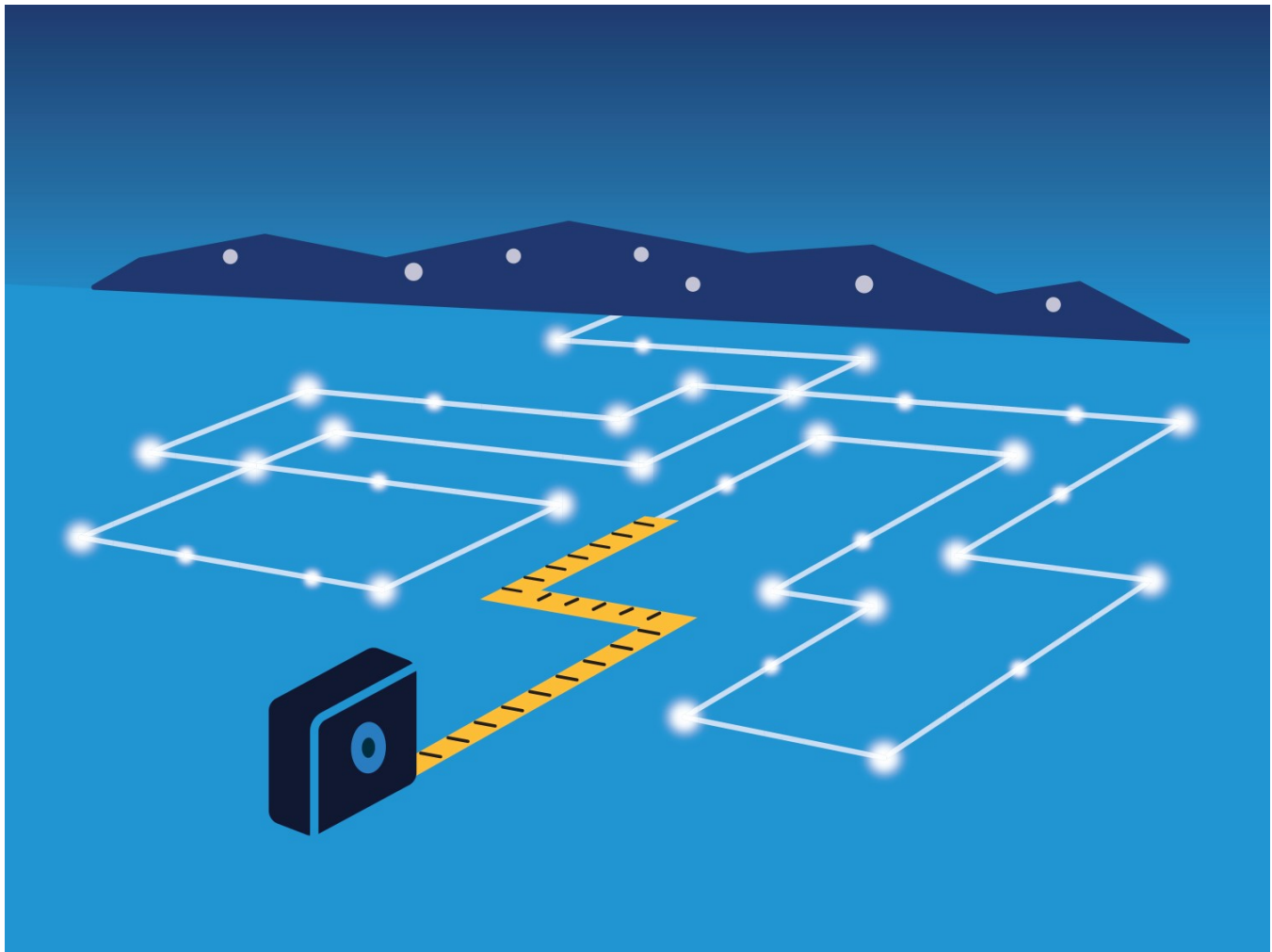


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Puget Sound Energy

2017-18 Multifamily Retrofit Program Evaluation Report

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1. Overall Conclusions and Recommendations

Puget Sound Energy’s (PSE) Multifamily Retrofit (MFRT) Program is designed to provide incentives to property managers and tenants for in-unit, common area, and building envelope measures. It is designed to increase the installation of cost-effective energy efficiency measures through building audits, direct installation of low-cost measures in units, and incentives for common area and building envelope measures. The program is mature, having operated since late 2006. Opinion Dynamics conducted a comprehensive evaluation of the program’s design and implementation in 2017 through mid-2018 and of the program’s energy savings in 2017.

The evaluation team verified the installation of program measures and evaluated associated savings via site visits and engineering desk reviews among a sample of 2017 participants. Further, the team used a series of qualitative and quantitative methods to evaluate the program’s design and implementation through mid-2018 by reviewing the MFRT Program Theory and Logic Model (PTLM), identifying key performance indicators (KPIs), analyzing data tracking records, and conducting interviews with program staff and customer participants. An evaluation of program performance in 2017-2018 with respect to these KPIs, as shown in the “Overall Program Health” column in Table 1, indicates how the program is performing in various respects.

Table 1. MFRT Key Performance Indicators

KPI	Definition	KPI Status	Overall Program Health	KPI Data Source
Electric savings	Amount of MWh savings for 2017	Ex-ante savings met 95% of 2017 goal		Program tracking data and MFRT EES 2017 Savings Reports for Electric and Gas Savings
Gas savings	Amount of therm savings for 2017	Ex-ante savings met 36% of 2017 goal		
Participation	Number of measures installed through the program (known as target units in PSE’s EES Tracking and Forecasting System) in 2017	90% of target units installed		
Persistence Rate	Percentage of measures reported as installed that are verified as installed through site visits	Strong persistence, 94% RR for kWh and 112% for gas		Site visits for 2017 impact evaluation
Conversion Rate	# of audits conducted that went on to receive rebates for deeper retrofits	35% over approximately 16 months		Audit and tracking data
Energy Conservation Awareness	Percentage of participants that increased awareness of EE	55% increased awareness of energy efficiency; recall is low		2018 Evaluation
Customer Satisfaction	Average score on a 1 to 5 scale	4.18 average from 2017-2018 participants		2018 Evaluation

The evaluation found that the program is capturing electric savings, garnering persistent savings, and providing excellent customer service. However, the program has struggled to meet its gas savings goals due, in part, to a lack of gas saving opportunities in the marketplace and the limited set of gas measures offered through the program. Additionally, because the MFRT program’s contribution to gas savings for the portfolio is small relative to its contribution to overall electric savings, PSE decided to focus on pushing the program’s electric savings since more measures offered under the program are electric. Program staff made changes in 2018 designed to help the program increase its gas savings in the 2018-2019 biennium. In addition to these changes, program staff should consider a few improvements to better demonstrate the value of the program in the marketplace through better data tracking and collection related to KPIs, as described in Sections 2.2 and 2.3 of this report. Further, improved tracking through the assignment of unique property identifiers will simplify PSE’s follow-up efforts with MF customers to encourage them to go beyond the free audit and free in-unit measures to the deeper energy saving measures.

Below the evaluation team describes the overall conclusions and recommendations related to four key aspects of the program addressed in this evaluation: 1. Design, 2. Implementation, 3. Participation & Marketing, and 4. Energy Savings.

1.1 Program Design Conclusions

The table below summarizes the design-related research questions and conclusions from this evaluation and references the section in the main report that provides further details.

Table 2. Program Design Findings Summary

Design Research Questions	Evaluation Finding	Section Reference
What is the program’s core theory of change?	The program is designed to address market barriers to energy efficiency through marketing, education, audits, and incentives. These activities are designed to ultimately lead to energy savings and customer satisfaction.	3.1.1
What are the KPIs?	Based on the PTLM, candidate KPIs for the program are: energy savings; participation rate; customer satisfaction; savings persistence; increased awareness of energy conservation among participants; and the conversion rate from audit/DI to rebated measures.	3.1.2
What improvements can be made, if any, to the PTLM and KPIs?	PTLM: Include additional barriers; Clarify documentation methods; Add “booster” efforts as an activity. KPIs: We recommend PSE add 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; We also recommend PSE make data tracking enhancements to allow for internal tracking of KPIs during implementation.	3.1.1 and 3.1.2
How is the program influencing customer decision-making for energy efficiency improvements in MF properties?	The program is designed to influence customer decision-making through audits, education and incentives. In practice, the program is influencing most participants to take action; the participant survey results revealed that over half of participants are likely influenced by the program, given their unlikelihood to have had an audit, installed free measures, or conducted energy efficient upgrades without the programs’ offerings.	3.1.3

PSE’s Biennial Conservation Plan (BCP) highlights maximizing participation from HTR and proportionally underserved segments as a key area of focus for achieving energy efficiency targets in the 2018-2019

biennium.¹ While the MF market itself is identified in the BCP as a HTR market, additional segments within the MF market may be harder-to-reach than others and may face greater barriers to energy efficiency; this includes low-to-moderate income, geographically isolated, and/or limited English customers. As such, the evaluation team developed a Geographical Information Systems (GIS) tool that maps MFRT-eligible customers across PSE’s service territory. Through mapping of program-eligible properties and an overlay of neighborhood-level census data regarding age of structure, heating fuel type, income, and cultural demographics, this GIS tool will allow PSE program staff to precisely target customers that align with the BCP’s overarching goals related to targeting Hard-to-Reach segments.

1.2 Program Implementation Conclusions

Per program implementation, the evaluation team explored how the program is implemented, what changes took place and why, what successes and challenges have occurred, what program staff is changing moving forward, feedback from participants on how the program is implemented and finally how the program tracks data and calculates ex-ante savings.

Overall, implementation is running smoothly with a few exceptions. In 2017, program staff implemented booster activities that were needed to approach the program’s electric saving goal, though it still struggled to meet its gas goal. As such, program staff made a number of changes in 2018 to increase the gas savings including adding more gas measures to provide property managers with additional gas saving opportunities.

The customer feedback on program implementation obtained via the web survey and interviews with property managers during site visits was very complimentary of both the program and PSE. Most participants were highly satisfied with the program’s key components, including the rebate, DI and audit portions of the program. Participants often highlighted the professionalism of the DI and audit staff as a key strength of the program. As one participant said, *“Great job done by the PSE workers who came into about 50 units and replaced bulbs, shower heads, wrapped pipes and replaced aerators. All took off their shoes when entering my unit and all were very pleasant to work with.”*

In addition to the overall favorable responses, feedback from full participants (those who go beyond the audit and free DI portions of the program) indicates that the program is motivating customers to engage with other PSE-developed channels, specifically the Contractor Alliance Network (CAN).² Half (50%) of the participants who completed a deeper upgrade through the program did so through the CAN.

The table below summarizes the implementation-related research questions and conclusions from this evaluation and provides a reference to the section in the main report for further details.

Table 3. Program Implementation Findings Summary

Implementation Research Questions	Evaluation Finding	Section Reference
How is the program currently implemented? What changes have occurred in 2018? When did those	Through its implementer, CLEAResult, the program provides free energy audits of MF properties to increase customer awareness of energy conservation and identify energy savings opportunities. The program then directly installs no-cost measures in tenant units, offers incentives for more complex upgrades, and refers customers to a contractor network for further	3.2.1

¹ 2018-2019 Biennial Conservation Plan, First Revision: December 7, 2017; Page 29

² After the program evaluation period, PSE informed the evaluation team that the CAN is in the process of rebranding to a wider Trade Ally strategy. Instead of providing referrals, customers will receive lists of Recommended Energy Professionals based on the types of projects recommended to them by auditors.

Implementation Research Questions	Evaluation Finding	Section Reference
changes happen? What changes is program staff planning for 2019 onward?	<p>assistance.</p> <p>In 2018, PSE discontinued clothes washer replacements and advanced power strips; added tankless water heater and storage tank water heater measures; expanded definition of a MF property.</p> <p>In 2019+, PSE will provide audit participants with a list of Recommended Energy Professionals per product category.</p>	
What success and challenges, if any, has program staff encountered so far?	<p>In 2017, the program conducted a number of “booster activities” to increase its achieved electric savings. Program staff instituted a one-time higher incentive for common area lighting projects and added temporary staff to increase DI projects, which led to boosted claimed kWh savings. Given the program was unable to meet its gas saving goal in 2017, 2018 efforts are largely focused on addressing this challenge.</p>	3.2.1
How do tenants and property managers experience the program and how can it be improved from their perspective?	<p>Most participants (66% or more) were highly satisfied with the program’s key components, including the rebate, DI and audit portions of the program. Only 5 of 71 survey respondents (7%) indicated dissatisfaction with the program. When asked why, participants cited issues with the audit, DI and rebate components in terms of these taking too long, staff arriving late for appointments or learning the measures they installed did not qualify for rebates.</p> <p>Twenty of the 71 participants surveyed (28%) offered recommendations to improve the program in general. Amongst this group, participants suggested simplifying the rebate process and offering more user-friendly DI products (LED bulbs too dim, need instructions for showerheads, need assistance with installation).</p>	3.2.2
Is there any uncertainty surrounding the deemed savings values? Are the deemed savings values appropriate or do they require updates?	<p>The Residential Building Stock Assessment (RBSA) specifies that most electrically-heated MF apartments use zonal heating equipment and most gas-heated MF apartments use central heating equipment such as forced air furnaces. Since the database does not track the electric heating equipment (e.g, furnace, heat pump, etc.), the team relies on RBSA data to appropriately apply RTF savings. We recommend PSE 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.</p> <p>Based on findings from the deemed savings review, the evaluation team also recommends PSE make some updates to the deemed value sources it is using. The evaluation team finds PSE’s deemed savings values, once staff makes the recommended changes, to be reasonable and without uncertainty.</p>	3.2.3
Are the deemed per-measure savings applied correctly in the 2017 database (where applicable)?	<p>Because the RTF does not provide deemed gas savings for thermostatic showerheads and adapters installed in homes with gas water heating, PSE converts the electric RTF deemed savings value to gas. However, PSE converted the RTF kWh values for “any” water heating fuel type when the tracking database indicates gas water heater. The evaluation team recommends PSE update the gas deemed savings value such that it converts the RTF deemed kWh savings for “electric” to therms instead of the RTF kWh savings for “any” water heater type.</p> <p>PSE converts the electric RTF deemed savings value to gas using the deemed values for electric zonal heating. The RBSA specifies that most gas-heated MF apartments use central heating equipment such as forced air furnaces. We recommend calculating therm savings by converting the RTF</p>	3.4

Implementation Research Questions	Evaluation Finding	Section Reference
	deemed electric savings for forced air furnaces instead of zonal. The RTF does not provide a deemed savings value for R-11 to R-38 attic insulation. It instead includes deemed values for R-0 to R-38 and R-19 to R-38. We recommend calculating deemed savings by determining the average deemed savings per R-value using the savings values provided in the RTF and multiplying it by the increase in R-value ($\Delta 27$) going from R-11 to R-38.	
Is PSE tracking all necessary data needed to assess impacts?	<p>The data largely meets the evaluation needs for the MFRT core program. The program currently tracks all data necessary to assess energy impacts. However, the team recommends a few data tracking enhancements that improve the ability to track additional program KPIs, such as a conversion rate from DI-only to rebated measures. The contact information for participants was often missing or incomplete. Data tracking currently lacks a consistent unique site identifier between the PSE program staff and implementer's database.</p> <p>The implementation team tried to correct records in the database that applied outdated deemed RTF savings values by adding corresponding negative records to cancel out the original positive records. However, this was not always executed successfully and resulted in underclaimed kWh savings. We recommend that PSE include flags in future program tracking databases identifying records to be included (or excluded) from the analysis.</p> <p>The evaluation team identified project records that appeared duplicative in the tracking database, but project documentation showed otherwise. To avoid confusion in the future, we recommend PSE include unique identifiers (e.g., installed unit number) in future program tracking databases to avoid unique measures from being mistakenly identified as duplicative.</p>	3.2.3

Based on the information provided in the table above, participants were very satisfied with the program and the DI component specifically. A total of 81% of respondents (29 out of 36) indicated a 4 or 5 for their level of satisfaction with the DI portion of the program (on a scale from 1 to 5). Only two participants said they were less than satisfied (i.e., selected a rating of 1 or 2 out of 5). Eighty-three percent of respondents had no additional feedback on ways to improve the DI component of the program. Of those who offered feedback, the comments related to the LED bulbs not being bright enough for elderly residents, not enough instructions provided on how to use the shower adapters, and needing assistance installing products that were instead left behind.

1.3 Participation & Marketing Conclusions

The evaluation team explored the program's marketing effectiveness and participation in the various components of the program. The table below summarizes the marketing and participation-related research questions and conclusions from this evaluation and provides a reference to the section in the main report for further details.

Table 4. Program Participation & Marketing Findings Summary

Research Question	Evaluation Finding	Section Reference
What marketing efforts were most effective in	PSE-led marketing efforts are the primary channel through which participants first learn of the MFRT program. Specifically, PSE's website,	3.3.5

Research Question	Evaluation Finding	Section Reference
reaching participants?	emails, other energy-efficiency programs, Energy Fairs and TV/print advertisements were the channels through which over half of respondents first heard about the program. Word-of-mouth serves as an efficient marketing channel, as 20% of participants heard about the program this way. Contractor-led efforts were another important channel through which participants heard about the program (17%).	
How did program participation compare to the expectations? How many projects were completed? What types of projects?	From January 2017 through July 2018 the MFRT program engaged with 865 unique properties by completing 493 audits, 703 DI projects, and 509 deeper saving retrofit projects. Amongst all participating property managers in 2017-mid 2018, 44% were “full” participants or participants that engaged in multiple components of the program (audit+rebated measures or audit+DI+rebated measures). The remaining 56% were “semi” participants having only engaged in no-cost components including the audit-only and audit+DI.	3.3.1
How many customers participated in more than one component?	Using 2017 as the starting point, the evaluation team calculated a conversion rate that shows 35% of sites converted to deeper retrofit projects during this time period. Survey results and on-site depth interviews with property managers suggest that the rate is actually higher. Survey results provide additional information that indicates the gap between stalled and full participants may be relatively small. Of the 71 participants surveyed, 72% had already converted to deeper projects or had solid plans to do so in the near-future. The majority of customers that participate in the program associate with a “manager” title to some degree. Also, more HOA presidents participate in the full components of the program compared to other titles, but HOA projects comprise a small percentage of projects. This indicates that HOAs may have deeper energy saving potential but larger barriers to participation under the current program design.	3.3.4

As shown in the table above, the marketing efforts are effective in attracting participation. Program efforts are also proving to encourage customers to participate in multiple program components and the program is encouraging a significant proportion of customers to convert to deeper retrofit projects beyond the audit and DI components.

1.4 Energy Savings

The table below summarizes the energy savings and realization rates for the 2017 program. Based on evaluated savings, the program achieved 16,920 MWh which represents a realization rate of 94% of the ex-ante electric savings PSE reported for that year. Though the program achieved only about one-third of its 2017 ex-ante gas savings goal, it did achieve 34,268 therms, which accounts for 112% of the ex-ante savings that PSE reported for 2017.

The slight decrease in electric savings from the ex-ante savings was primarily due to low persistence rates for power strips. Reported savings for power strips account for approximately 14% of the program’s overall savings in 2017. Site visit results revealed low persistence rates for power strips (19%) which ultimately impacted the electric savings realization rate. Given that the program discontinued this measure in 2018 and the evaluation team did not find any other significant issues affecting the persistence of electric savings, the realization rate for electric savings should improve in 2018.

The main driver of increased gas savings from the ex-ante value is due to differences in deemed savings for windows, insulation, thermostatic restrictor adapters and showerheads. These measures alone account for 5% of the total sampled reported gas savings but contribute to 91% of the discrepancies in gas savings.

Table 5. Energy Savings Findings

Component	Research Question	Evaluation Finding	Section Reference
Energy Savings	What were the estimated gross energy (electric and gas) impacts from the 2017 program year?	16,920,492 kWh savings and 34,268 therm savings	3.4
	What are the electric and gas realization rates for the program?	94% for electric and 112% for gas based on a deemed savings review, engineering desk review and site visit verification.	3.4

1.5 Recommendations

In this section the evaluation team provides the list of recommendations that came out of the research and evaluation activities conducted of the PSE MFRT program.

Program Design Recommendations

- **We recommend PSE update its 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.
- **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.**
- **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.**

Program Implementation Recommendations

- Based on the deemed savings review, **the evaluation team recommends PSE make some changes going forward for the deemed value sources it is using.**
 - 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” 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.

- 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.
- The RTF does not provide a deemed savings values for R1 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.
- Although participants surveyed for this evaluation are overall satisfied with the DI measures offered through the program,³ **the evaluation team recommends incorporating their 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.

Participation & Marketing Recommendations

Below, the team recommends a few improvements related to marketing to help the program continue to attract participants to the program in general and to help increase the conversation rate to retrofit projects even further.

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.

To attract more participants to the program in general:

³ DI refers to all the free (non-rebated) measures offered through the program. In 2017 these DI measures included: LEDs of various wattages, showerheads, showerhead adaptors, faucet aerators, water heater pipe wrap, and advanced power strips.

- **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).

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 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.

2. Evaluation Methodology

This section summarizes the research objectives as well as the data sources and methodologies used to conduct this evaluation of the Multifamily Retrofit (MFRT) program.

2.1 Research Questions

The goals of this evaluation were to evaluate the program's design, implementation and performance. To this end, the evaluation addressed the following research questions:

Design

- What is the program's core theory of change? What are the Key Performance Indicators (KPI)? What improvements can be made, if any, to the Program Theory and Logic Model (PTLM) and KPIs?
- How is the program influencing customer decision-making for energy efficiency improvements in multifamily (MF) properties?

Implementation

- How is the program currently implemented? What changes have occurred in 2018? When did those changes happen? What changes is program staff planning for 2019 onward?
- What success and challenges, if any, has program staff encountered so far in 2018?
- How do tenants and property managers experience the program and how can it be improved from their perspective?
- Are the deemed per-measure savings applied correctly in the 2017 database (where applicable)?
- Are the deemed savings values appropriate or do they require updates?
- Is there any uncertainty surrounding the deemed savings values?
- Is PSE tracking all necessary data needed to assess impacts?

Participation & Marketing

- How did program participation compare to the expectations? How many projects were completed? By how many different customers? What types of projects?
- Did customer participation meet expectations? If not, how different was it and why? How many customers participated in more than one component?
- What marketing efforts were most effective in reaching participants?

Energy Savings

- What were the estimated gross energy (electric and gas) impacts from the 2017 program year?
- What are the electric and gas realization rates for the program?

2.2 Data Sources

The evaluation team used information provided by Puget Sound Energy (PSE) program staff and the program implementer, CLEAResult, as well as primary data collected during site visits. Table 6 maps the data sources with the corresponding evaluation activities.

Table 6. Data Sources and Evaluation Activities

Data Source	Evaluation Activity				
	Web Survey	Database Review	Site Visits	Desk Review	Deemed Savings Review
Project Tracking Data collected by MFRT program staff	X	X	X	X	
Audit Tracking Data collected by Implementer	X	X	X		
Participant Data with Contact Information	X	X	X		
Direct-Install 'Tally' Workbooks at the Site/Unit-Level		X	X		
Project Documentation for Custom Projects at the Measure-Site Level collected by PSE's engineering staff		X		X	
Business Cases and Source of Savings Documentation		X			X

Detailed descriptions of the data sources and their roles in the evaluation are presented below.

2.2.1 Project Tracking Data Collected by MFRT Program Staff

MFRT tracking data is recorded at the project-site level for the MFRT core program. PSE first provided the evaluation team with a database including projects rebated from 2017 and subsequently provided data for projects through Q2 2018. The team used the 2017 data for the impact evaluation (e.g., estimation of ex post gross energy savings, development of 2017 realization rates, and sampling basis for site visits). For the process evaluation, the team used all provided tracking data to develop unique site identifiers for all participating properties and associated contacts, as well to identify each property's participation type based on the measures received (see Table 7).

Table 7. Classification of MFRT Program Participants

Participant Type	Participant Identifier	Service/Measures Received
Stalled	A	Audit only
	B	Audit + DI measures only
Full	C	Audit + rebated measures only
	D	Audit + DI measures + rebated measures

The evaluation team updated a property's participation type upon receipt of the 2018 tracking data (e.g., if a participant only received free DI measures in 2017 but then received attic insulation in 2018, they were changed from a stalled type B participant to a full type D participant). This served as the program participation roster for the web survey and determined the question mix a given participant received.

2.2.2 Audit Tracking Data Collected by Implementer

The audit tracking data collected by the program implementer detailed rebate eligibility and site characteristics for all properties that received an audit between January 1, 2017 and May 5, 2018. The evaluation team used the audit database for the process evaluation to identify stalled participants that did not appear in PSE's tracking data because they only received an audit, and at the time of this evaluation, had not gone on to receive rebated or free measures through the program (Type A participants). Since neither the implementer nor PSE currently tracks participation at the unique site-level, the evaluation team mapped the audit database to PSE's project tracking data by site address, and assigned unique site IDs for any addresses not included in the previous source.⁴ Upon receipt of the 2018 project tracking database, the team repeated this data cleaning and unique site ID allocation process to determine whether or not any Type A participants went on to deeper participation within the study period.

2.2.3 Participant Contact Information at the Project-Level

The evaluation team required participating property manager's contact information to deploy the web survey as well as to recruit for site visits. Since MFRT program staff does not consistently track property manager contact information for participating properties, the evaluation team received contact information from a variety of sources (e.g., implementer project data, PSE customer data by address, and implementer audit data), and then aggregated and mapped this information to the corresponding sites identified in the previously discussed sources. A majority had no contact information at all. Because of the multiple participant contact data sources covering a range of dates (some overlapping and some not), numerous sites often had one or more contacts associated with them. As further detailed under the process evaluation methodology, the finalized list of unique contacts served as the web survey and site visit recruitment sample pools.

2.2.4 Direct-Install 'Tally' Workbooks at the Site-Level

The program implementer tracks the measure type and quantity of DI measures installed at or provided to a given property at the unit-level in what are called DI 'tally' workbooks. The evaluation team received all DI tally workbooks for installations completed from January 1, 2017 to July 31, 2018 and used them to conduct intra-site sampling for each DI measure associated with properties that the team recruited for site visits. Note that these workbooks are not unique at the site-level but are instead created each time the implementer goes to a site. To the evaluation team's knowledge, the unit-level installation data tracked in these workbooks are not compiled in a central database. As a result, the team often found inconsistencies between the number of units served according to these workbooks compared to the number of units served in the MFRT tracking database.

2.2.5 Quality-Control (QC) Packages for Custom Calculated Projects

PSE custom calculated energy savings for several 2017 MFRT measures, including boilers, ductless heat pumps, common area lighting, and air sealing. Discussions with PSE's engineering team revealed that their staff performed energy savings calculations using project documentation ("QC Packages") consisting of installed measure specifications, findings from site visit verifications, invoices, final applications, project details, and lighting calculation workbooks (for common area lighting projects). The evaluation team leveraged data from desk reviews and site visits to algorithmically calculate savings. The evaluation team

⁴ During the mapping process, the evaluation team noticed numerous address inconsistencies between the audit and project databases (e.g., a property's address is listed as '123 Ocean Lane' in one database, but '123 Ocean Ln.' in the other). Although these were corrected when encountered, it is possible that some identical sites were given different unique IDs.

received QC Packages for 60 properties and used them to complete desk reviews and prepare for a subset of site visits.

2.2.6 Business Cases and Source of Savings Documentation

The evaluation team completed a detailed deemed savings review of all 2018 MFRT measures. This review assessed the reasonableness of 2018 deemed savings values and provided recommendations for improving existing methodologies, calculations, and assumptions. The deemed savings review required an examination of PSE's measure-specific Business Cases and Source of Savings (SoS) documentation to identify potential areas of improvement. PSE can use the results from the deemed savings review to inform 2019 MFRT planning savings values. Since this report focuses on the impact evaluation for 2017 participation solely, recommendations for updating deemed savings are not included. Instead, the evaluation team used information provided in the 2018 Business Cases to help identify if savings were misapplied and SoS documentation (when applicable) to understand the derivation of the deemed savings for 2017 measures.

2.3 Impact Evaluation Methods

The impact evaluation focuses solely on savings from the 2017 program year. This differs from the process evaluation, which is based on information gathered about the program and from participants for both 2017 and the first half of 2018. The evaluation team performed the following steps to calculate total evaluated energy savings for the 2017 MFRT program:

- **Step 1. Perform a database review.** The evaluation team performed a thorough review of the 2017 program tracking database to identify database errors and/or missing data. Based on these findings, the evaluation team adjusted reported savings and summarized the implications of these adjustments on the overall reported energy savings.
- **Step 2. Select representative sample.** Evaluated savings are based on results from a representative sample of participating properties. The team used a simple random sample design to select properties that receive both electric and gas fuels from PSE. Properties that receive either electric or gas fuels from PSE were stratified based on total property savings. Therefore, all impact activities only include the evaluation of measures installed at the properties within the representative sample.
- **Step 3. Review application of deemed savings for representative sample.** For measures included in the representative sample, the evaluation team confirmed that PSE applied the correct deemed savings values to measures where the savings approach is either Regional Technical Forum (RTF)-deemed or PSE-Derived (see Table 9 below for savings approach by measure). The evaluation team updated deemed values where needed and used the updated savings when extrapolating to the population.
- **Step 4. Perform desk reviews for representative sample.** The evaluation team performed desk reviews for 60 unique properties and used the findings to:
 - Prepare for site visits. The evaluation team completed desk reviews for the set of 35 properties for which site visits were planned. Desk reviews provide an overview of each project identifying measure types, product specifications, and installed quantities, all information that is used to prepare for site visits (e.g., estimate site visit duration, determine intra-site sampling strategies if applicable, plan for the types of data points to collect, etc.). The success of each site visit relies on findings and preparation from desk reviews but note that evaluated savings depend on findings from site visits and not from desk reviews.

- Adjust energy savings. The evaluation team performed desk reviews for an additional 25 properties with custom calculated measures (mostly consisting of boilers and common area lighting (CAL)). The team used findings from the desk reviews to not only verify the accuracy of the reported savings against data found in project documentation (e.g., invoiced quantities, measure specifications, etc.) but also to adjust energy savings calculations and use these savings when extrapolating to the population.
- **Step 5. Conduct site visits for representative sample.** The evaluation team completed site visits for 35 properties consisting of a mix of RTF-deemed, PSE-derived, and custom calculated measures. During the site visits, the team not only confirmed the quantity and type of installed measures for properties that received DI measures, but also gathered equipment specifications for custom calculated measures. The team calculated evaluated savings using results from site visits which were later used to extrapolate to the population. Note that the team performed intra-site sampling for properties where large quantities of measures were installed. These were rolled up to the property level prior to extrapolating to the overall population.
- **Step 6. Extrapolate to the population.** Using results from Step 3 through Step 5, the evaluation team calculated realization rates using the ratio adjustment method⁵ by property fuel type (e.g., electric, gas, and combo). The team applied the realization rates to total population savings to arrive at the overall evaluated kWh and therm savings, as well as overall program realization rates.

The following sections provide more details for each step described above.

2.3.1 Deemed Savings Review

The team reviewed PSE's deemed savings assumptions for reasonableness. Notably, PSE is receiving a concurrent Biennial Electric Conservation Achievement Review (BECAR), which will assess whether PSE is accurately applying the current 2018 deemed savings values. To avoid duplication with this effort, the team focused the deemed savings review on whether the deemed values are based on the most updated version of the RTF and whether the assumptions and savings values fall within the expected range.

The team found that PSE uses three types of deemed savings, including:

- **RTF Deemed:** Original unadjusted per-measure savings values determined by the RTF;
- **RTF Adjusted:** RTF deemed savings values adjusted using PSE-specific characteristics (e.g., saturation rates, service territory characteristics); and
- **PSE Derived:** Deemed savings values from source(s) independent of the RTF that use algorithms and assumptions from PSE-specific data or various sources that align with program-specific measure characteristics and design.

Deemed savings values utilize sources including the RTF, other states' technical reference manuals (TRM), ENERGY STAR specifications, and third-party technical studies. The review of deemed savings assumptions covered all savings types and sources. The team gave special focus to PSE-Derived deemed savings values as they have not been through rigorous outside stakeholder review (i.e., through the RTF).

2.3.2 Sample Design for Evaluated Savings

⁵ Levy, P.S. and Lemeshow, S. 2008. *Sampling of Populations: Methods and Applications* (4th Ed). Hoboken: John Wiley & Sons, Inc.

The evaluation team based evaluated savings on the performance of installed measures for a representative sample of participating MFRT properties. The MFRT program provided incentives to 540 unique properties in 2017. The representative sample is comprised of 60 unique properties - 35 properties for which the team completed site visits and 25 properties that installed either common area lighting projects or custom calculated measures (e.g., boiler, ductless heat pumps, etc.) for which no site visits were conducted (Please refer to Section 2.3.5 for site visit sample design details).

The team calculated evaluated energy savings only for the measures installed at the 60 properties within the sample, since the sample is representative of the entire population. The team used a combination of three different evaluation methods (e.g., deemed savings application, desk review, and site visits) to calculate evaluated savings. Table 8 identifies the number of properties that relied on the different methods when calculating evaluated savings. For example, 22 properties included measures that relied on the results from the deemed savings application. Note that the sum of the values in the table will not total to the 60 unique sampled properties since evaluated savings sometimes rely on more than one method.

Table 8. Evaluated Savings Methods for Properties in Represented Sample (n=60)

Deemed Savings Application	Desk Review	Site Visit
22	60	35

2.3.3 Application of Deemed Savings

The evaluation team examined the program tracking data to determine how well the PSE tracking database aligns with the assumptions and algorithms documented in applicable program materials and other relevant sources (e.g., SoS Database, RTF). Additionally, the team assessed the application of deemed savings within the database, identified errors, if any, and verified that the applied deemed savings resulted in the total reported savings provided in the program tracking database.

Table 9 identifies which program measures apply a deemed savings value and which require custom calculations.

Table 9. 2017 PSE Savings Approach by Measure

Measure	Savings Approach
Advanced Power Strip	Deemed Savings Value
Attic Insulation	
Clothes Washer	
ENERGY STAR Refrigerator	
Floor Insulation	
Low-Flow Showerhead	
Low-Flow Showerhead w/ Thermostatic Restrictor Adapter	
Thermostatic Restrictor Adapter	
Thermostats	
Wall Insulation	
Water Heater Pipe Wrap	
Windows	
Faucet Aerator	
Gas Fireplace	
Gas Furnace	
Integrated Space and Water Heating	
Lighting (In-Unit)	Custom Calculated
Ventilation Fan	
Air Sealing	
Boiler	
Ductless Heat Pump	Custom Calculated
Lighting (Common Area)	

2.3.4 Desk Reviews

The team conducted engineering desk reviews based on project documentation consisting of equipment invoices, project applications, lighting calculation workbooks, product specifications, and other supporting project files. For each desk review, the evaluation team performed the following tasks:

- Checked the data for data entry errors, omissions, or inconsistencies by comparing project documentation, such as invoices, to the program-tracking data extract,
- Calculated evaluated gross energy savings based on the detailed information in the project files and compared those savings to the program-tracking data, and
- Used the evaluated savings for measures installed in properties not undergoing a site visit to extrapolate to the population.

For properties with planned site visits, the team:

- Used measure data from project documentation to prepare for site visits (e.g., build data collection tool, perform intra-site sampling, etc.).

2.3.5 Site Visits

The evaluation team completed site visits for 35 properties. During the site visits, the team recorded the quantity and type of installed and operational measures. The team used site visit results to calculate persistence rates for measures installed in apartment units including LEDs, faucet aerators, showerheads,

thermostatic restrictor adapters, power strips, as well as common area lighting. The team gathered additional equipment specifications to inform evaluated energy savings calculations for those measures that require custom calculations (e.g., boilers, ductless heat pumps). The team then compared findings from the site visits to the information provided in the project documentation and the program-tracking database. Where discrepancies were found, the team updated savings based on site visit results.

Sampling Approach

The team first determined an overall sample size using an error ratio of 0.5 (chosen based on sampling best practices, the maturity of the retrofit program, as well as the evaluation team’s experience with other similar MF programs) and arrived at a sample of 40 projects total with 12.5% anticipated precision at the 90% confidence level. The team then determined the number of sites to visit across the three site types defined by fuel used (gas-only, electric-only, and combo).⁶ The team selected a simple random sample for combo sites (due to the small population of sites with projects covering both fuel types) and a non-proportional stratified random sample with stratum quotas for electric-only and gas-only sites. The non-proportional stratified random sample is calculated by first using the Dalenius and Hodges (1959)⁷ method to determine stratum boundaries and then applying an allocation scheme known as the Neyman allocation⁸, which allocates sample quota for a given stratum that produces the lowest variance for the fixed population size. The team selected this sample design methodology as it allows for the greatest certainty of impacts with the fewest sample points from the 2017 participant population. The sample design parameters, including the strata boundaries and the number of unique sampled properties from each fuel strata are summarized in Table 10.

Table 10. Sampling Summary for Site Visits of 2017 Participants

Fuel Type	Stratum	Range (kWh or Therms)	Population (N)	Sample Size (n)
Electric	1	50 - 20,000	238	3
	2	20,001 - 100,000	167	9
	3	100,001 - 575,000	40	13
Gas	1	1 - 100	29	2
	2	101 - 500	29	2
	3	501 - 2,500	14	6
Combo	All	All	23	5
Total			540	40

Table 11 shows the proportion of ex-ante savings reached via the site visits by comparing the savings from the sample to the overall savings.

Table 11. Proportion of Ex Ante Savings for Sampled Site Visits

	kWh	Therms
Ex Ante Savings in Sample	4,937,154	14,637
Total Ex Ante Savings	18,013,074	30,536
Percent of Total Ex Ante	27%	48%

⁶ Fuel type was determined by the savings claimed (i.e., kWh, therms, or both) for a given property in the program tracking data.

⁷ Dalenius, T. and Hodges, J. L. (1959), “Minimum Variance Stratification,” *Journal of the American Statistical Association*, 54, 88-101.

⁸ Neyman allocation, after Neyman (1934) as described in Cochran, W. G. (1977), *Sampling Techniques* (Third Edition), John Wiley and Sons, New York

Achieved Sample

Due to cancellations during the week of site visits (as a result of more than one property manager failing to notify tenants of entry 48 hours prior to the scheduled visits); the evaluation team completed five fewer site visits than initially planned. Table 12 shows the achieved sample of completed site visits compared to the planned sample for each fuel type.

Table 12. Site Visit Sampling by Savings Type for 2017 Properties

Fuel Type	Total Unique Sites (N)	Planned Sample Size	Completed Site Visits
Electric	445	25	25
Gas	72	10	8
Combo	23	5	2
Total	540	40	35

Intra-Site Sampling for Installation Verification

The evaluation team performed intra-site sampling for common area lighting measures and measures installed in apartment units. Project documentation and DI tally workbooks aided development of the intra-site sample prior to the scheduled site visits. Table 13 was used to determine the required number of measures to verify to satisfy a 20% precision at 90% confidence, as specified by the California Energy Efficiency Evaluation Protocols for the basic level of rigor.⁹ The ratio between the required number of measures to verify (n) and the total number of installed measures at the property (N) is nonlinear as the ratio between n and N decreases as N increases.

Table 13. Number of Measures to Verify

N	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	100	120	250	300	400
n	3	4	5	5	6	6	7	7	10	12	13	13	14	14	15	15	16	16	17	17

Since the implementer provided DI tally workbooks in advance of site visits, the evaluation team could identify which units received which measures and therefore sampled at the site-measure level using only the units that received the measures as the sample frame. For example, if 100 showerheads (N=100) were installed at a site, then the team would need to verify 15 showerheads (n=15) to achieve verification at the 90/20 level. If there are 150 units (U=150) in the complex that received a showerhead, then the evaluation team would expect to find showerheads in 66% of the units and the team would need to visit $u=n*U/N$ units (or 22.5 units) to verify the required number of showerheads (assuming the DI tally workbooks show that showerheads were evenly distributed across the units). Note that the evaluation team capped the number of tenant unit visits at 20 for an individual site to avoid over burdening property managers. The team calculated the u for each measure selected for a site visit and visited enough units to satisfy the largest u (capped at 20). Once the u was selected, all of the energy efficient measures in those units were verified, so some measures achieved a better precision than 20% at 90% confidence.

⁹ TecMarket Works, 2006. California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals. Prepared for the California Public Utilities Commission. April 2006, p. 167.

2.4 Process Evaluation Methods

2.4.1 Participant Depth Interviews During Site Visits

The evaluation team completed semi-structured in-depth interviews with property managers while conducting site visits. This involved a discussion with property managers that focused on the following:

- How the property managers heard about the program and how they enrolled;
- Property managers' decision-making structure and process for performing energy efficient upgrades at their property;
- Interest in and plans to complete deeper retrofits through the program (where applicable); and
- Experience and satisfaction with the program and PSE/implementation staff.

2.4.2 PSE Program Staff Interviews

The evaluation team completed semi-structured in-depth interviews with PSE program managers and asked specific questions about the following interview topics:

- Program implementation and design, including KPIs;
- Recent and planned program changes;
- Program marketing efforts;
- Data tracking methods and available program data;
- Sources of deemed savings values and any uncertainties around deemed savings; and
- Suitability of planned evaluation tasks.

2.4.3 Data Tracking and Materials Review

The evaluation team requested and reviewed PSE program materials, including:

- MFRT PTLM;
- Program tracking data;
- Program materials;
- Customer or program partner contact information; and
- Deemed savings assumptions, including business cases.

The team completed a basic review of the latest version of PSE's MFRT program PTLM (see Figure 1). This review included an assessment of whether all the standard PTLM components (i.e., inputs, activities, outputs, and outcomes) are present and whether the information in the PTLM reflects the evaluation team's understanding of the program's design.

2.4.4 KPI Review

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

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

Notably, PSE considers energy savings, participation, and program spending as KPIs for all its programs including MFRT. The evaluation team reviewed these KPIs but focused the analysis on additional ones that would help program staff assess the performance of program operations (e.g., participant satisfaction, conversion from audit to retrofit), market penetration, and achievement of policy goals (e.g., reaching HTR markets).

2.4.5 Participant Survey

This section details the methodology and sampling approach for both the stalled participant and full participant surveys. Detailed results of the stalled participant and full participant survey, including frequency tables for every question, are available in Appendix A.

The evaluation team implemented a web survey to gather feedback from MFRT participants. Participants were sent an initial email invitation with three reminder emails for a total time in the field of just over two weeks. The team used a census approach to contact all available sample points, however, if a participant requested removal from the list after the first invitation, the participant received no follow-up and was removed from sample. This occurred for 16 participants. The following sections detail the sample approach and the resulting survey completes.

Sample Design

Given the size of the participant population and the lack of reliable contact information (in part due to high turnover in the residential property management industry), the evaluation team did not sample property managers for this survey effort. Instead, the team attempted to contact property managers at each site that participated in the program between January 1, 2017 and July 31, 2018.

The team took several steps to develop a participant population frame from MFRT program-tracking data, discussed in detail below. In total, the evaluation team identified 402 unique property manager contacts and achieved 71 completes. The survey was fielded from October 15, 2018 to October 31, 2018.

As noted above, the team attempted to reach a census of property managers and therefore there is no sampling error associated with the survey results. However, the team did identify other sources of potential error, which are discussed in the Key Findings Section.

Sample Development

Since the property manager survey was designed to gather feedback from both full and stalled participants who participated in 2017 or through Q2 of 2018, the team combined PSE program staff's MFRT project tracking database with the implementer's audit database for sample development. The databases received

from the implementer used different systems of unique identifiers for properties and projects, thus requiring the team to develop a method to bring all records to the property street address level.¹⁰ Table 14 shows the resulting participant population in terms of the mix of components participants received during the study period. Approximately one-fifth of MFRT properties (21%) received only an audit during the evaluation period and just over one-third received DI measures only. A total of 44% had some type of rebated upgrade completed and of these, 13% engaged in multiple program components. Per the implementer, some property owners participate in multiple components across the span of multiple program years. Thus, the program’s cumulative level of cross-component participation is likely to be higher than what the evaluation data represents.

Table 14. Overview of MF Properties by Program Component

Program Component Participation	Properties	% of Properties
		(n=865)
Audit Only (from 1/1/2017 to 5/5/2018)	184	21%
Rebated Measures	170	20%
DI Measures	306	35%
Common Area Lighting	91	11%
Multiple Components, including:	114	13%
<i>Common Area and DI</i>	21	2%
<i>Common Area and Rebated Measures</i>	10	1%
<i>DI and Rebated Measures</i>	75	9%
<i>Common Area, DI, and Rebated Measures</i>	8	1%
Total	865	100%

Note: Due to rounding, column totals may not sum to 100%.

From this population of MFRT program participants, the evaluation team developed a sample frame for survey fielding. The team flagged duplicate contacts (based on name and email) and cleaned the database to ensure that a given email address was only contacted regarding one property. Roughly 48% of the unique properties in the population (n=422) had either incomplete contact information or had the same contact information associated with multiple properties). In the case where multiple properties were associated with the same contact information, the team kept the property that had gone the furthest in the program. For instance, if the same contact had an audit-only property and a DI and rebated property, they were surveyed about the property that underwent DI and rebated measures. The sample frame also excluded property managers who had no contact email or contact name. The team attempted a census of program participants with the resulting sample frame (n=443). Table 15 summarizes the participant counts for the initial population, the resulting sample and the completed surveys. The 16% response rate is expected due to the challenges of surveying a HTR population.

¹⁰ Original identifiers in the program staff and implementer datasets (Property Name/Property ID) represented different groupings of property components both within and across datasets. Based on a review of the datasets, *Property IDs* were not unique for the same sites (e.g., the property name/ID would change if the property changed management or ownership) and were not the same across datasets (e.g., one database would use an abbreviation for a property name while the other would contain the entire name). In addition, one structure on a larger campus could have one or multiple Project IDs and/or street addresses. While a single property’s physical makeup might consist of either an individual building or a multi-building complex, for merging datasets, the team defined a property as a unique street address.

Table 15. MFRT Survey Participant Counts

Participant Type	Population		Sample Frame		Completed Surveys		Response Rate
	Participants	%	Participants	%	Participants	%	
A. Stalled (audit only)	184	21%	79	18%	8	11%	10%
B. Stalled (audit + DI only)	300	35%	131	30%	24	34%	18%
C. Full (audit + rebated measures only)	270	31%	153	35%	23	32%	15%
D. Full (audit + DI + rebated measures)	111	13%	80	18%	16	23%	20%
Total	865	100%	443	100%	71	100%	16%

Survey Objectives and Structure

The survey sought to gain feedback on the participant’s experience, satisfaction and suggested areas of improvement for the program. Amongst full participants, the survey gained feedback about the decision-making associated with installing rebated measures through the program. Amongst stalled participants, the survey explored awareness of rebated measure options, likelihood of rebated measure installation in the future and barriers to installation. To this end, the survey instrument focused on gaining answers to the following research questions included in the evaluation plan for this program:

- What marketing efforts were most effective in reaching participants?
- How do property managers and tenants experience the program and how can it be improved from their perspective?
- How is the program influencing customer decision-making for energy efficiency improvements in MF properties?

Table 32 in Appendix A summarizes the survey structure, participant types, and research objectives/topics by section.

3. Detailed Evaluation Findings

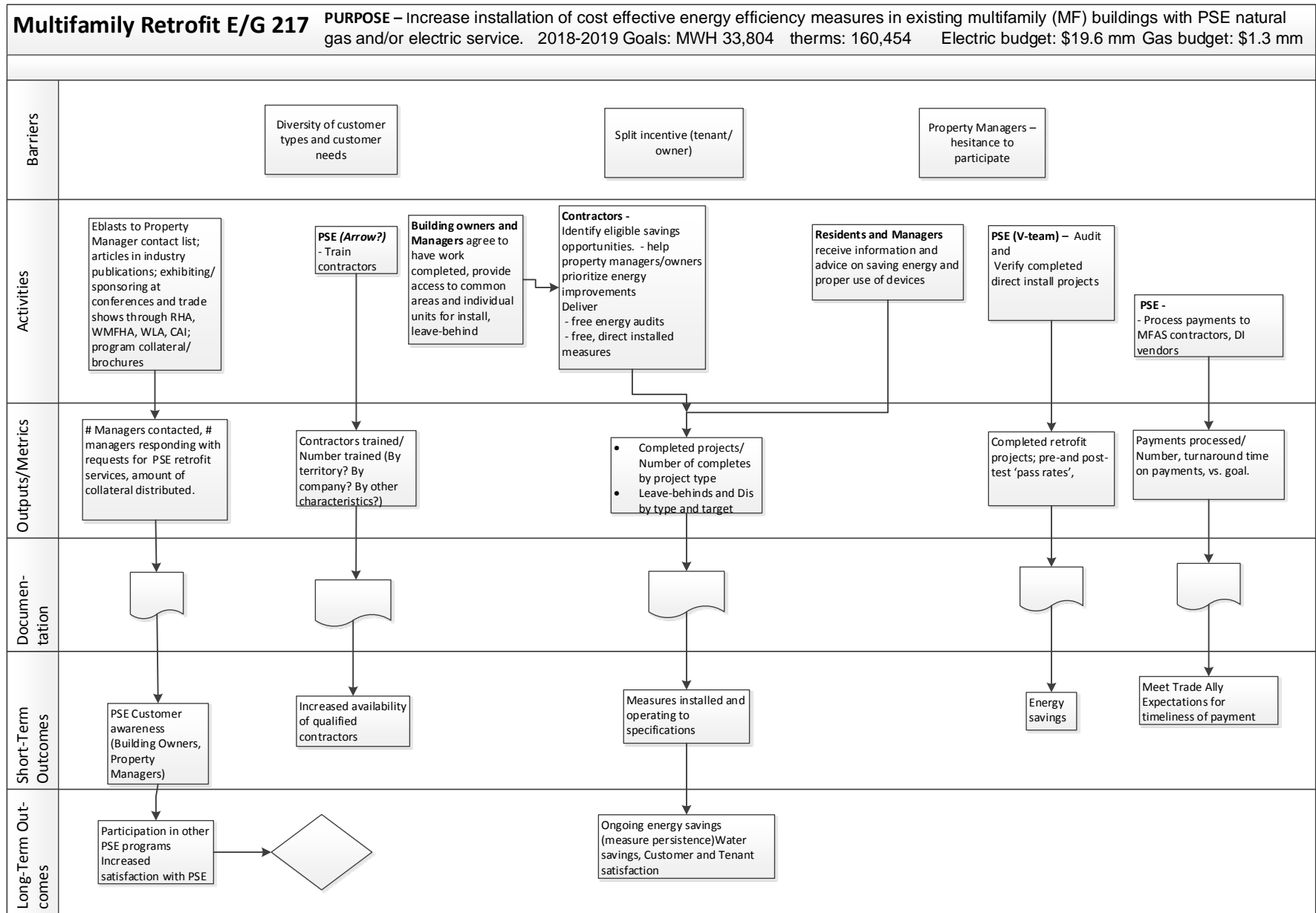
The following section details findings concerning the evaluation's key focus areas: Program Design, Implementation, Participation & Marketing, as well as Energy Savings.

3.1 Program Design

3.1.1 Program Theory and Logic

PSE's MFRT program is designed to provide incentives to property managers and tenants for in-unit, common area, and building envelope measures. The program is mature, having operated since late 2006 and is designed to increase the installation of cost-effective energy efficiency measures in existing MF buildings with five or more attached dwelling units. Figure 1 shows the most current PTLM for the program. The program is designed to address market barriers to energy efficiency through marketing, education, audits, and incentives. These activities are designed to ultimately lead to energy savings and customer satisfaction.

Figure 1. MFRT Program Theory Logic Model



Program Theory and Logic Model Recommendations

Based on a review of the program’s current PTLM, the evaluation team recommends the following revisions to ensure that the model accurately reflects the activities it conducts to achieve the long-term outcomes, the market barriers the program is addressing, and the documentation it plans to produce as outputs:

- **Include additional barriers.** Reviews of similar MFRT energy efficiency programs reveal additional barriers that may also affect sites in PSE’s service territory.¹¹ These barriers include a lack of available data about energy use and retrofit performance in MF property settings and a lack of awareness about financing available to MF building owners who are interested in making energy efficiency improvements.
- **Clarify documentation methods.** The current PTLM contains a placeholder for “documentation” referring to documents or databases that track program outputs. The PTLM does not provide specific information on the form of documentation prepared by program staff. Though not a requirement of PTLMs, the team recommends program staff describe the databases or documents they use to track outputs from the program.
- **Account for “booster” strategies PSE employs, as needed, to achieve energy savings goals.** The evaluation team learned that PSE staff instituted a limited-time-offer for some common area lighting projects towards the end of 2017 to achieve its energy savings goals. In addition, they hired temporary implementation staff to increase DI projects. These strategies helped to boost kWh savings for the program, but the PTLM does not currently reflect these critical activities that led to the program’s long-term desired outcome of producing a certain amount of electric savings in 2017.

3.1.2 Key Performance Indicators

The main long-term objective of the program is for MF properties to reduce overall energy use in both common areas and in tenant units through the installation of energy efficiency equipment and increased awareness of energy conservation. As such, PSE program staff rely on energy savings and participation as KPIs. However, based on a review of the program design and theory, there are several other performance metrics that PSE should consider when evaluating this program, including measure persistence for DI measures, participant satisfaction, awareness of energy conservation, and the conversion rate of DI projects to rebated measure installation (i.e., getting participants to go beyond free measures).

Table 16 presents PSE’s previously established KPIs during the evaluation period and proposed KPIs the evaluation team recommends PSE consider adopting to assess the ongoing success of the MFRT program and includes the data sources available to the evaluation team to evaluate these KPIs. Using these KPIs to evaluate the program’s performance in 2017-2018, as shown in the “Overall Program Health” column, it is clear the program is performing well across several KPIs with the exception of its ability to meet its 2017 gas savings target. The program fell below its gas target for 2017 and program staff mentioned that this is an ongoing issue for the program given the lack of gas project opportunities in the market.

¹¹ Regional Energy Efficiency Organizations, Multifamily Energy Efficiency Retrofits: Barriers and Opportunities for Deep Energy Savings, December 2016. <https://www.swenergy.org/data/sites/1/media/documents/publications/documents/SWEEP-Multifamily-Report.pdf>

Table 16. MFRT Key Performance Indicators

Metric	Definition	Success Criteria	KPI Status	Overall Program Health	KPI Data Source
Electric savings	Amount of MWh savings for 2017	18,985 MWh	Ex-ante savings met 95% of 2017 goal		Program tracking data and MFRT EES 2017 Savings Reports for Electric and Gas Savings
Gas savings	Amount of therm savings for 2017	84,536 therms	Ex-ante savings met 36% of 2017 goal		
Participation	Number of measures installed through the program (known as target units in PSE's EES Tracking and Forecasting System) in 2017	11,205,368 units*	90% of target units installed		
Persistence Rate**	Percentage of measures reported as installed that are verified as installed through site visits	TBD**	Strong persistence, 94% RR for kWh and 112% for gas		Site visits for 2017 impact evaluation
Energy Conservation Awareness	Percentage of participants that increased awareness of energy efficiency	TBD**	55% increased awareness of energy efficiency; recall is low		2018 Evaluation Results
Conversion Rate**	Number of audits conducted versus number of participants receiving rebates for deeper retrofits	TBD**	35% over approximately 16 months		Audit database and program tracking data
Customer Satisfaction**	Average score on a scale	TBD**	4.18 average from 2017-2018 participants***		2018 Evaluation Results

*Units are based on 11,026,100 units for Electric and 179,268 units for Gas.

**Recommended by the evaluation team.

***In this evaluation, participants were asked about their satisfaction with the program based on a 0 to 5 scale where 0 is completely unsatisfied and 5 is completely satisfied. However, PSE does not gather this information internally on an annual basis.

In 2019, PSE established MFRT implementer KPIs that when met, are linked to a financial incentive to help keep the team on track towards the achievement of electric and therm savings. These KPIs require the implementer and PSE to track operational efficiency, customer satisfaction, and energy savings.

Key Performance Indicator Recommendations

Based on this review of KPIs, the evaluation team recommends the following to PSE:

- **Track and count the number of converted participants in the biennium.** PSE could base a goal on historical performance or assumptions behind 2018-2019 savings goals. Setting this as a goal

would first require PSE to track participants as they move from the audit to rebate-eligible measure portions of the program. Currently the program implementer maintains the audit database, while PSE tracks completed projects through its own system. Due to property name differences between the two databases (e.g., PSE often uses a six-digit code, whereas the implementer includes the full name of the property) and minor discrepancies in how street addresses are captured (e.g., PSE often spells out “Lane” whereas the program implementer uses abbreviations), there is no way to easily map the databases to one another. Creating a system for developing and assigning unique site identifiers that are consistent across the separate databases would allow PSE to track participant conversion rates in real time and enable the tracking of several other useful performance metrics, including the average duration of time participants take to apply for rebated measures after receiving the initial audits. The evaluation team developed a conversion rate by flagging those participants that went on to receive deeper measures after having an audit between January 1, 2017 to May 12, 2018 or only initially participating in the DI portion of the program during 2017.¹² While 35% of sites converted during this time period, survey results and in-depth interviews conducted during site visits suggest that the number is actually higher as this rate does not account for those sites that received an audit or DI measures pre-2017 as the evaluation team did not have this data. In addition, several rebated retrofits are significant projects for properties and therefore cover a longer time span. The team discusses this in greater detail in Section 3.3.4.

- **Consider adding MFRT participants to PSE’s quarterly Customer Insights Survey and adopting the customer satisfaction success criterion used by the Home Energy Assessment Program.** To ensure consistency with other programs’ success criteria, which is a score of 8.5 or greater out of 10, PSE may want to shift to a 0 to 10 customer satisfaction scale. For the purposes of this study, the evaluation team used the satisfaction scalar and scores developed from the property manager survey, the results of which are further detailed in Section 3.2.2.
- **Consider tracking the number of HTR participants in the future.** Currently the MFRT program’s participation (or unit) KPIs are tied to energy savings, but the program should instead consider tracking participation by HTR properties. PSE has larger cross-cutting goals for its residential portfolio of programs to better target, serve and track energy efficiency efforts in harder-to-reach sectors. The BCP highlights maximizing participation from HTR and proportionally underserved segments as a key area of focus for achieving energy efficiency targets in the 2018-2019 biennium.¹³ While the MF market itself is identified in the BCP as a HTR market, additional segments within the MF market may be harder-to-reach than others and may face greater barriers to energy efficiency; this includes low-to-moderate income, geographically isolated, and/or limited English customers. As such, the evaluation team developed, per PSE program staff request, a Geographical Information Systems (GIS) tool that maps MFRT-eligible customers across PSE’s service territory. Through mapping of program-eligible properties and an overlay of neighborhood-level census data regarding age of structure, heating fuel type, income, and cultural demographics, this GIS tool will allow PSE program staff to precisely target customers that align with the BCP’s overarching goals related to targeting HTR segments. PSE may develop further HTR KPIs based on their efforts to further define and target sub-segments of the MF market that may be harder-to-reach than others.

3.1.3 Program Influence on the Marketplace

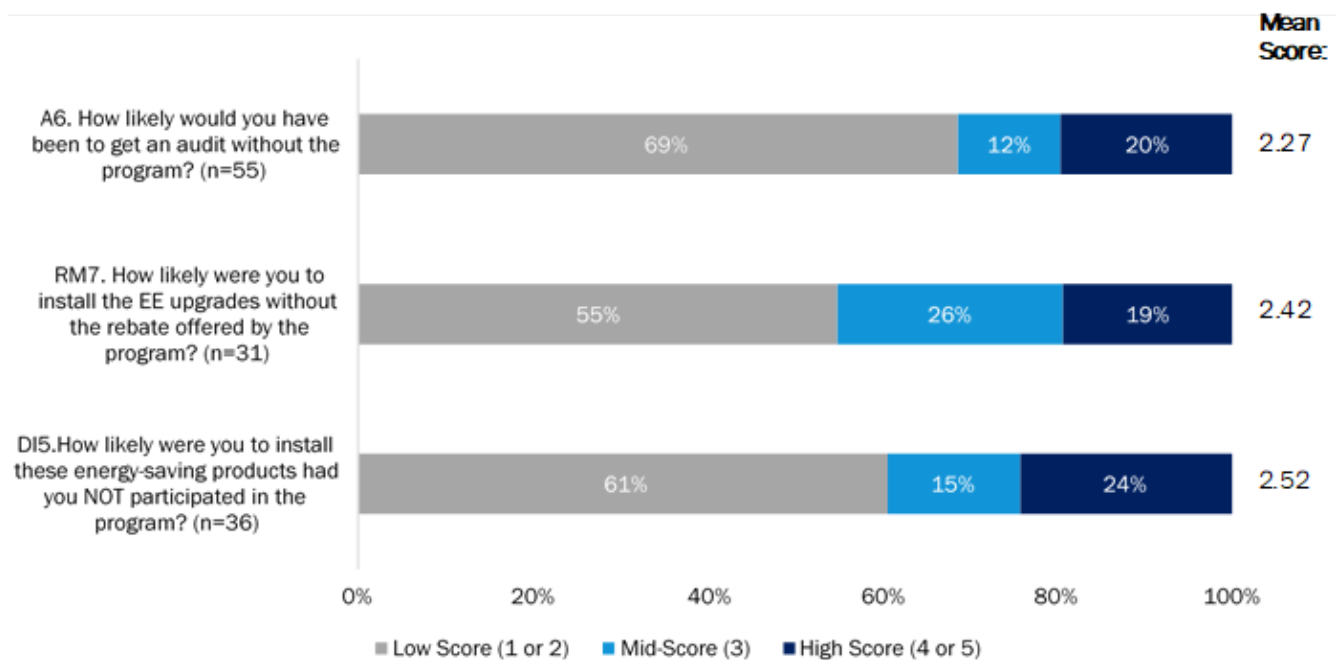
¹² These participants most likely received an audit before January 1, 2017 and therefore were not included in the audit database but were still eligible for ‘conversion’ to deeper rebated measures.

¹³ 2018-2019 Biennial Conservation Plan, First Revision: December 7, 2017; Page 29.

The MFRT program is designed to influence customers to install energy efficient products in multiple ways. The program can encourage customers to purchase a more energy efficient version of a product by lowering the price through rebate offers and providing information about the lower operation costs of the equipment. It can nudge customers to purchase a product they were already considering but had not purchased because the price was too high. The program can also expose customers to products they had not been considering.

Based on a survey of participants, current program design influences most participants to install energy efficiency products (see Figure 2). A combination of responses to program influence questions show that over half of participants are not likely ‘free-riders’, given their tendency to report they would not likely have had an audit, installed free measures, or conducted energy efficient upgrades without the program’s offerings. It is worth noting that where the evaluation team could compare responses across participant types (for the audit and DI influence questions), there were no statistically significant differences in the likelihood to adopt a program component for stalled (DI only) versus full (DI+rebate) participants.

Figure 2. MFRT Participant Reported Influence*



*Figure Note: Scale defined “1” as “Not At All Likely” and “5” as “Very Likely”

3.2 Implementation

In this section, the evaluation team discusses MFRT program implementation, including key successes and challenges faced during 2017-2018 implementation, program changes in 2018, as well as anticipated changes in 2019 and beyond. Further, this section delves into how the program calculates ex-ante savings and if any improvements are needed.

3.2.1 Implementation Overview

Through its implementer, CLEAResult, the program provides free energy audits of MF properties to help owners, operators, and tenants better understand energy consumption and energy savings opportunities. Depending on the results of the energy audit, the program will directly install no-cost measures¹⁴, as well as provide incentives for more complex upgrades.

Once a property decides to have an audit and allows for the installation of no-cost DI equipment, implementation staff leaves behind materials for tenants that provide energy savings tips and describe how the directly-installed equipment works. For example, upon thermostatic showerhead installation at a given unit, the installer provides tenants with a PSE-branded brochure that explains how to use this type of showerhead and its energy savings benefits.

The program offers both prescriptive and calculated incentives. Prescriptive incentives are offered for most in-unit lighting, space heat, water heat, appliances and operations and maintenance improvements. Calculated measures involve commercial-grade upgrades such as boilers and solar pool heaters. In 2018, the program discontinued clothes washer replacements and added water heater measures. The program is also considering adding new measures such as tub-spout diverters.

The program implementer verifies measure installation at the site, ensuring that projects are completed to the agreed scope before any incentives are paid to the participating property. PSE staff also independently verifies equipment installation for a fraction of the sites and accompanies the implementer on quarterly “ride alongs” to oversee the implementer’s verification activities.

Through conversations with PSE MFRT program staff, the evaluation team explored their perspective on the program's key successes and challenges. MFRT staff reported that despite a boost in electric savings due to mid-program design changes (e.g., a one-time common area lighting incentive increase at the end of 2017 and hiring temporary staff to boost installation of DI measures), the program fell slightly short of its goal. Program staff also noted that they were unable to meet the 2017 natural gas goals for the program due to a shortage of natural gas projects. Nevertheless, at the time of the interview, MFRT staff felt that the program had performed well over its 12 years of operation, as evidenced by its achievement of electric savings goals.

Program staff also identified changes to program implementation that occurred in 2017-2018 and changes that they plan to implement in this biennium. In early 2018, program staff revised the list of the program’s available rebated measures, adding a number of natural gas measures that better align the MFRT rebates to that of PSE’s single family retrofit program. Such changes are designed to help the program increase gas savings. The program also expanded its definition of a MF property to simplify the rebate process for property owners that own multiple properties on one parcel of land. With the previous definition, these types of properties had to apply for multiple rebates through the single-family programs for each building. Now, the property owner can apply for rebates for all buildings at once through the MFRT program. To streamline project implementation in 2018, the MFRT program started to waive pre-audits for one-off condo insulation projects if a contractor from the CAN is used and waive pre-approvals on incentive applications for one-off condo window and insulation projects.

Table 17 summarizes the results of the program staff interviews.

¹⁴ These measures include LEDs, faucet aerators, thermostatic restrictor showerheads, and water heater pipe wrap.

Table 17. MFRT Program Staff Interview Findings

2017-2018 Key Successes	2017-2018 Key Challenges	2017-2018 Key Implementation Changes	2018-2019 Planned Implementation Changes
<ul style="list-style-type: none"> ▪ Program staff instituted a one-time higher incentive for certain common area lighting projects towards the end of 2017, which led to the completion of several quick turnaround projects that boosted claimed kWh savings. ▪ PSE brought on temporary implementation staff towards end of the 2017 program year to increase installation of DI measures and increase claimed kWh savings. 	<ul style="list-style-type: none"> ▪ Program came close to meeting electric savings goal but was unable to meet its gas savings goal. ▪ Staff turnover on the implementation team played a role in the program’s ability to drive production. 	<ul style="list-style-type: none"> ▪ By the beginning of 2018, PSE discontinued clothes washer replacements and stopped offering advanced power strips as a leave behind measure. ▪ In 2018, PSE added tankless water heater and storage tank water heater measures. ▪ Program expanded its definition of a MF property, which is now five or more units on a continuous land parcel. 	<ul style="list-style-type: none"> ▪ In 2019, rebranding the CAN to a Trade Ally strategy which provides customers with a list of Recommended Energy Professionals by product category. ▪ Streamlining processing of one-off condo jobs related to window and insulation projects. ▪ Lowered 2019 electric and gas savings targets for program. ▪ In 2019, added vendor KPIs associated with a financial incentive for meeting them to keep implementation on track.

3.2.2 Implementation Feedback from Participants

The evaluation team inquired with participating property managers about their experiences with program participation. Below the team provides their feedback, which is largely positive, along with suggestions for improvement from their perspective.

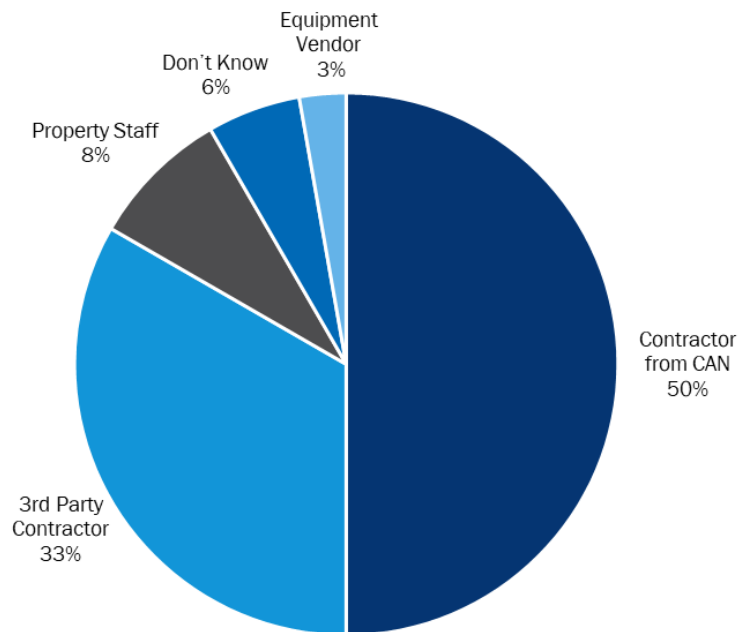
PSE Customer Relationship with MF Property Managers

Survey responses and site visit feedback was largely positive. Participant feedback was complimentary of both the program and PSE. Respondents often highlighted the professionalism of the DI and audit staff as a key strength of the program. As one participant said, *“Great job done by the PSE workers who came into about 50 units and replaced bulbs, shower heads, wrapped pipes and replaced aerators. All took off their shoes when entering my unit and all were very pleasant to work with.”*

In addition to the overall favorable responses, feedback from full participants indicates that the MFRT program leads property owners to engage with other PSE-developed channels, specifically the CAN. As displayed in Figure 3, the majority of participants who completed an upgrade through the program did so through the CAN. Nine of the 17 respondents who did use a CAN contractor found the contractor through PSE efforts. Some of the participants who did not have the upgrade performed through a CAN contractor expressed a lack of awareness of the service. This indicates a potential opportunity to capture more rebated projects through increased awareness of the CAN among MF property managers.

Figure 3. Rebated Customers Use of PSE's Contractor Channel

RM2. Who performed the installation of the energy efficiency equipment for which you received financial incentives? (n=36)*

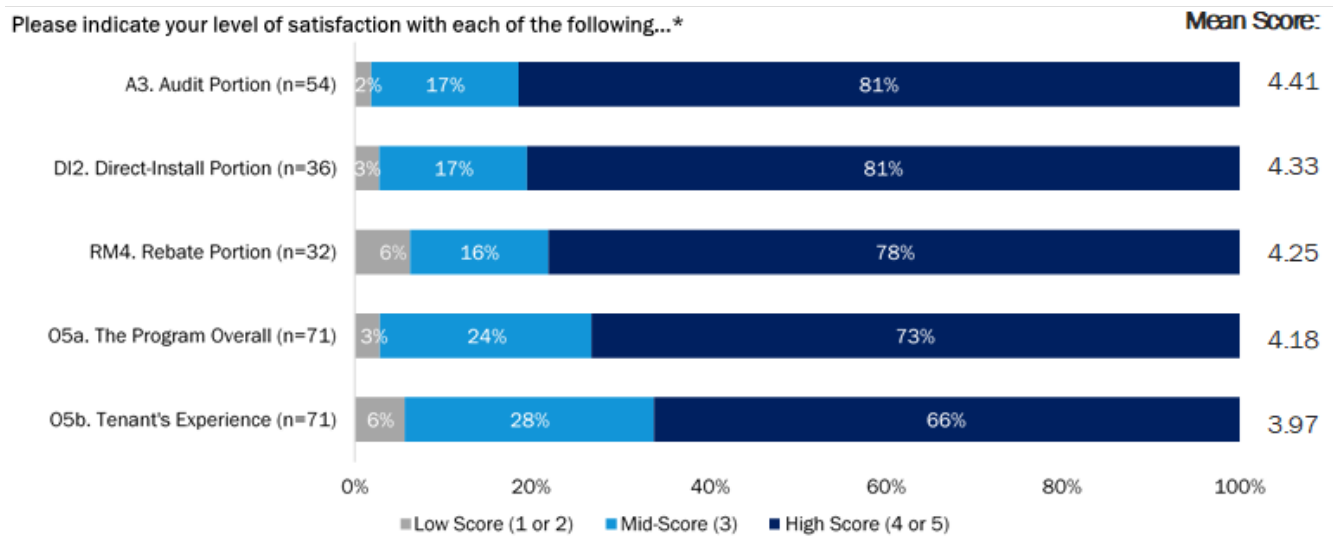


*RM2 was asked based upon which upgrade(s) respondents reported receiving (i.e., common area lighting, building envelope, appliance etc.). The percentages above are expressed in terms of total upgrades performed as reported by respondents.

Program Customer Service

Participating property managers and their tenants noted satisfaction with their program experiences. For example, most participating property managers were highly satisfied with the program's key components, including the rebate, DI and audit portions of the program (see Figure 4).

Figure 4. Participant Satisfaction



*Based on responses to the following questions: A3. Please indicate your level of satisfaction with the audit experience overall. DI2. Please indicate your level of satisfaction with the products. O5a. Please indicate your level of satisfaction with the program overall. O5b. Please indicate how you think the tenants would rate the program. RM4. Please indicate your level of satisfaction with each of the following: The rebate application process and forms, the rebate amounts offered, the products eligible for rebates, assistance in finding contractors to install rebate-eligible measures, the installation quality, the product quality, and the energy savings you experienced after installation. [average score of all components]. Totals may not sum to 100% due to rounding. Satisfaction Scale defined “1” as “Not At All Satisfied” and “5” as “Very Satisfied”.

For the overall satisfaction questions (Figure 4), only 5 respondents indicated they were less than satisfied with the program overall or that their tenants would rate the program as less than satisfactory. When asked to elaborate, these respondents offered non-categorical explanations about their reasons for their dissatisfaction. Among the small percentage who indicated dissatisfaction with the audit, DI and/or rebate components (4% n=2, 6% n=2, and 19% n=6 respectively), the drivers of dissatisfaction are as follows¹⁵:

- **Audit Component:** the audit took too long, did not teach me anything new and the inspector showed up late/was disorganized.
- **DI Component:** the installer showed up late and the tenants did not like the products.
- **Rebate Component:** the rebates were not large enough, found out the expected rebates did not qualify until well into the process, the rebate application was complicated, and it took too long to receive the rebate.

The evaluation team also asked respondents for suggestions to improve the program overall, as well as what could be done to improve each of the three distinct components of the program (i.e., the audit, DI, and rebate portions). While respondents rarely mentioned any major issues with the program, about 20 of the 71 property managers (28%) offered program improvement recommendations. The respondents who did offer suggestions indicated that simplifying the rebate process, offering more user-friendly DI products, and conducting better follow-up after audits and more proactive communication with property managers would improve the program (Table 18). Specific feedback related to DI products dealt with LED bulbs not being bright enough for elderly residents, not enough instructions for how to use the shower adapters, and needing assistance installing products that were instead left-behind.

¹⁵ Based on summarized/ paraphrased respondent open-ends.

Table 18. Suggestions for Program Improvement from Survey Respondents

Comment Type*	Program Component (%)			
	Audit	DI	Rebate	Overall
Total Answering	55	36	32	71
Feedback related to improving communication (wanting additional information/clarification/follow-up from program)	4%	8%	6%	6%
Simplify Program Processes (e.g., application, forms, requirements etc.)	2%	0%	9%	0%
Use Different Products	0%	6%	0%	0%
Increased Rebates/Shorter Pay-back needed for Expensive Upgrades	0%	0%	9%	4%
Non-categorical (did not answer question for how the program could be improved)	5%	3%	9%	3%
Positive Feedback, No Suggestions for Improvement	13%	8%	19%	10%
No Suggestions for Improvement	76%	75%	47%	77%

*Categories developed from open-end responses to questions, A5, DI4, RM6 and C1

3.2.3 Program Data Tracking and Ex-Ante Savings Approach

To further evaluate implementation, the evaluation team explored the comprehensiveness of the program tracking data, the data tracking quality and the deemed savings values applied to each measure. Below are the key findings in these areas.

Data Tracking for Evaluation

The evaluation team initially requested data from program staff in May 2018 and reviewed it for quality and completeness. The data largely met the evaluation needs for the MFRT core program. Table 19 summarizes data review findings.

Table 19. MFRT Summary of Data Tracking Review

Data Category	Required Data Points	Received (Y/N)	Data Issues
Program Implementation Materials	N/A	Y	None
Participant information	Property manager/owner name, contact information, participation dates	Y	Incomplete email contact information for survey effort
Measure-level data	Measure categories, types, link to participant	Y	None
Audit database	Customer information, recommendations received, additional tracking data	Y	None
SoS	Measure savings and assumptions	Y	None
Detailed Project Documentation	List of 43 QC packages that include EME-calculated measures for impact analysis/onsite visit data collection tool purposes	Y	None
Property ID	Unique identifier for each participating property, used in all PSE and implementer databases	N	Lacks unique identifier per property

The program currently tracks all data necessary to assess energy impacts. However, the team recommends a few data tracking enhancements that would improve PSE’s ability to track additional program KPIs, such as a conversion rate from DI-only to rebated measures. The contact information for participants was often missing or incomplete. Additionally, many of the contacts were no longer affiliated with the property and the team often spoke to their replacements who had no knowledge of the program or only a vague recollection. The high level of turnover within the MF industry presents a challenge for PSE to stay engaged with properties as they undergo changes in management firms and/or personnel. Nevertheless, data tracking practices can reduce the extent of the issue.

Data tracking currently lacks a consistent unique site identifier between the PSE program staff and implementer’s database (and the lack of contact information in the tracking databases), making it a challenge to track a property’s engagement with the MFRT program over time. Participating property identification is especially important for tracking a conversation rate (especially since this engagement often spans several years and involves multiple touchpoints). Enhanced data tracking methods that allow program and/or implementer staff to easily follow-up or check-in with participants at varying stages in the program will allow PSE to maintain the property-level relationships necessary for encouraging participants to move beyond the no-cost components of the MFRT program.

Database Quality

The evaluation team reviewed the 2017 MFRT program tracking database to assess the quality of information, identify potential anomalous entries, outliers, and missing values, and confirm that the total energy savings within the database matches the total reported savings. As part of this review, the team

discovered that the 2017 database included measures where the deemed per-measure savings value used an outdated RTF value. The implementation team tried to correct the database by adding a corresponding negative record, but this correction was not always successful. The corresponding negative records were added to the database with the intent to cancel out the original positive records, but the original positive records were removed from the database. Therefore, the resulting savings for these records are negative instead of zero. This occurred for 7,792 thermostatic restrictor adapters and 1,073 thermostatic restrictor showerheads, resulting in negative 812,464 kWh savings.

The evaluation team adjusted the database to incorporate these findings from the database review. Table 20 shows that reported electric savings are underclaimed by 812,464 kWh (4.5%).

Table 20. Database Review Savings Impacts

	Reported Savings	Adjusted Savings	Difference
MFRT program kWh	17,661,529	18,473,993	- 812,464
MFRT program Therms	30,536	50,536	-

Deemed Savings Application in Program Records

The evaluation team conducted a deemed savings review of all program measures based on what was applied in 2018. The purpose of the review was to determine whether the program is applying the most recent and appropriate deemed savings value available for the purposes of 2019 planning. Table 21 identifies the current savings source that PSE is applying for each measure in the 2018 database. In 2018, PSE relied on deemed savings assumptions from multiple sources, including: the RTF, past evaluation program data, the Arkansas TRM, a 2013 Michigan Water Metering Study, a 2000 Seattle Study, Residential Building Stock Assessment (RBSA) data for CFL persistence rates, Simplified Energy and Enthalpy Model (SEEM) software, and ENERGY STAR calculators.

Table 21. MFRT Deemed Savings Approach for 2018 Measures

Measure	Savings Source ^a	Current Deemed Savings Approach
LEDs	PSE Derived	Calculated using algorithms and assumptions from multiple sources and weighted using RBSA CFL persistence rates
Aerators	PSE Derived	Calculated using algorithms and assumptions from multiple sources
TRV Adapter	RTF Deemed	Deemed value from RTF (v1.3)
Tub Spout Auto-Diverter	N/A	New measure to be introduced in 2019. Existing savings calculations not yet finalized and unavailable for assessment
Showerheads	RTF Deemed	Deemed value from RTF (v3.1)
Showerhead w/ TRV	RTF Deemed	Deemed value from RTF (v3.1)
Water Heater Pipe Insulation	RTF Deemed	The measure was removed from the RTF site and therefore the evaluation team is unable to identify the version from which the value originated
Advanced Power Strips	RTF Deemed	Deemed value from RTF (v1.3) for IR-sensing power strips and RTF (v2.4) for PC-interacting power strips
ENERGY STAR Refrigerator	RTF Deemed	Deemed value from RTF (v4.3)
ENERGY STAR Clothes Washer	RTF Deemed	Uses deemed savings from the RTF (v5.4) to calculate an average deemed savings value for top-loading and front-loading clothes washers

Measure	Savings Source ^a	Current Deemed Savings Approach
Clothes Washer (Common Area)	PSE Derived	Calculated using algorithms and assumptions from multiple sources
ENERGY STAR Clothes Dryer	RTF Deemed	Deemed value from RTF (v1.4)
Heat Pump Clothes Dryer	RTF Deemed	Deemed value from RTF (v2.0)
Electronic Line Voltage Thermostat	RTF Deemed	Deemed value from RTF (v3.1)
Web Enabled Thermostat	RTF Deemed	Deemed value from RTF (v3.1)
Air Source Heat Pump	PSE Derived	Calculated using algorithms and assumptions from multiple sources
Ductless Heat Pump	RTF Deemed	Deemed value from RTF (v2.2)
ENERGY STAR Gas Furnace	PSE Derived	Calculated using results from a furnace study to adjust savings for an ENERGY STAR compliant furnace. Savings adjusted assuming MF space heating is 75% of the heat load and square footage
ENERGY STAR Gas Boiler	PSE Derived	Calculated using ENERGY STAR calculator for gas boilers and adjusted assuming MF space heating is 75% of the heat load and square footage
High-efficiency Fireplace	PSE Derived	Calculated using algorithms and assumptions from multiple sources
Integrated Space and Water Heat	PSE Derived	Calculated using results and assumptions from multiple sources
Gas Storage Water Heater (EF 0.67)	PSE Derived	Calculated using algorithms and assumptions from multiple sources
Gas Tankless Water Heater (EF 0.90)	PSE Derived	Calculated using algorithms and assumptions from multiple sources
Heat Pump Water Heater	RTF Adjusted	Deemed value from RTF (v3.4) adjusted by 85% for unknown reasons
ENERGY STAR Whole House Ventilation with or without Air Sealing	PSE Derived	Calculated using algorithms and assumptions from multiple sources
Air Sealing	PSE Derived	Calculated using custom calculator that incorporates actual blower door results from a sample of projects
Insulation	PSE Derived	Deemed savings based on output data from SEEM modeling software
ENERGY STAR Door	PSE Derived	Calculated using algorithms and assumptions from multiple sources
Windows	RTF Deemed	Deemed value from RTF (v3.4)

^a Source: 2018 MFRT Business Cases and SoS documents. PSE Derived refers to deemed savings values from source(s) independent of the RTF that use algorithms and assumptions from PSE-specific data or various sources that align with program-specific measure characteristics and design. RTF Deemed refers to original unadjusted per-measure savings values determined by the RTF. RTF Adjusted refers to RTF deemed savings values adjusted using PSE-specific characteristics (e.g., saturation rates, service territory characteristics).

Based on the deemed savings review, the evaluation team recommends PSE make some changes going forward to ensure it will apply the most recent and applicable deemed savings values available across the

various sources. Note that the evaluation team finds PSE’s deemed savings values along with those recommended below to be reasonable and without uncertainty. The evaluation team reviewed all measures; however, Table 22 only includes measures for which the team recommends changes going forward.

Table 22. MFRT Key Findings and Recommendations from Deemed Savings Review

Measure	Key Findings from 2018	Recommendation for 2019 Planning
LEDs	<ul style="list-style-type: none"> Some variables within the PSE derived calculation rely on the RTF but reference an outdated version (v4.2) 	<ul style="list-style-type: none"> Update RTF dependent assumptions using the most current version of the RTF (v6.1)
	<ul style="list-style-type: none"> Savings calculations reference electric interactive effects when calculating gas heating penalties. 	<ul style="list-style-type: none"> Revise calculation workbook to reference the gas interactive effect values instead of electric.
	<ul style="list-style-type: none"> Savings are weighted by existing lamp type using RBSA CFL persistence rates 	<ul style="list-style-type: none"> Consider tracking actual removed lamp type (e.g., incandescent, halogen, CFL) to derive PSE-specific saturation rates
Aerators	<ul style="list-style-type: none"> The RTF recently added aerators to the energy savings library in May 2018 	<ul style="list-style-type: none"> Adopt RTF (v1.1) deemed savings values and assumptions Convert RTF kWh for electric to therms for those with gas water heaters Remove embedded installation rate of 90%
TRV Adapter	<ul style="list-style-type: none"> Savings calculations reference deemed savings values from an older version of the RTF (v1.3) 	<ul style="list-style-type: none"> Update deemed values to those in the most current version of the RTF (v2.0) Convert RTF kWh for electric to therms for those with gas water heaters
Showerheads	<ul style="list-style-type: none"> Deemed savings from the RTF (v3.1) is for any home type 	<ul style="list-style-type: none"> Apply RTF (V3.1) deemed savings value for MF homes Convert RTF kWh for electric to therms for those with gas water heaters
Showerhead w/ TRV	<ul style="list-style-type: none"> Savings calculations reference deemed savings values from an older version of the RTF (v1.3) 	<ul style="list-style-type: none"> Update deemed values to those in the most current version of the RTF (v2.0) Convert RTF kWh for electric to therms for those with gas water heaters
Water Heater Pipe Insulation	<ul style="list-style-type: none"> Deemed savings are no longer supported by the RTF 	<ul style="list-style-type: none"> The RTF site removed all traces of savings for this measure. Update deemed values using other creditable sources
ENERGY STAR Clothes Washer	<ul style="list-style-type: none"> PSE used data from the RTF (v5.4) to calculate an average deemed savings for front loading and top loading clothes washers 	<ul style="list-style-type: none"> Apply the appliance specific deemed savings from the most current version of the RTF (v6.1) when the clothes washer type is known
		<ul style="list-style-type: none"> Consider performing additional research (e.g., collect clothes washer type) to calculate a weighted savings using the appliance specific deemed values in the RTF (v6.1) when the clothes washer type is unknown
Clothes Washer (Common Area)	<ul style="list-style-type: none"> Deemed savings are PSE Derived using multiple sources. 	<ul style="list-style-type: none"> Update deemed values to those in the most current version of the RTF (v5.1)
Air Source Heat Pump	<ul style="list-style-type: none"> Applied deemed savings from the Dealer Channel Space Heat program 	<ul style="list-style-type: none"> The evaluation team was unable to assess the reasonableness of assumptions for this measure and instead compared the deemed savings value to other sources. The savings values align with other sources for

Measure	Key Findings from 2018	Recommendation for 2019 Planning
		single family (SF) applications. To remain consistent with savings calculations for other MFRT HVAC measures, conduct additional research from multiple sources (e.g., RBSA, Residential Energy Consumption Survey or RECS, PSE data, etc.) to determine an adjustment rate to account for MF homes having smaller heating and cooling loads compared to SF and update savings calculations accordingly
ENERGY STAR Gas Furnace ENERGY STAR Gas Boiler	<ul style="list-style-type: none"> ▪ Deemed savings applies a 75% adjustment rate to account for smaller conditioned floor area and heating loads for MF homes. PSE is unable to supply the original source 	<ul style="list-style-type: none"> ▪ Conduct additional research (e.g., RBSA, RECS, PSE data, etc.) to compare the applied adjustment rate against MF assumptions from multiple sources and update savings calculations accordingly
Heat Pump Water Heater	<ul style="list-style-type: none"> ▪ Savings calculations reference deemed savings values from an older version of the RTF (v3.4) 	<ul style="list-style-type: none"> ▪ Update deemed values to those in the most current version of the RTF (v4.1)
Heat Pump Water Heater	<ul style="list-style-type: none"> ▪ Deemed savings applies an 85% adjustment rate to account for smaller water heating loads for MF homes. PSE is unable to supply the original source 	<ul style="list-style-type: none"> ▪ Conduct additional research (e.g., RBSA, RECS, PSE data, etc.) to compare the applied adjustment rate against MF assumptions from multiple sources and update savings calculations accordingly
Insulation	<ul style="list-style-type: none"> ▪ Deemed savings based on output data from SEEM modeling software 	<ul style="list-style-type: none"> ▪ Consider updating deemed savings values to those in the most current version of the RTF (v3.4) to remain consistent with other PSE programs ▪ Apply RTF deemed values for zonal heating for electric savings and convert RTF deemed values for FAF for gas savings.

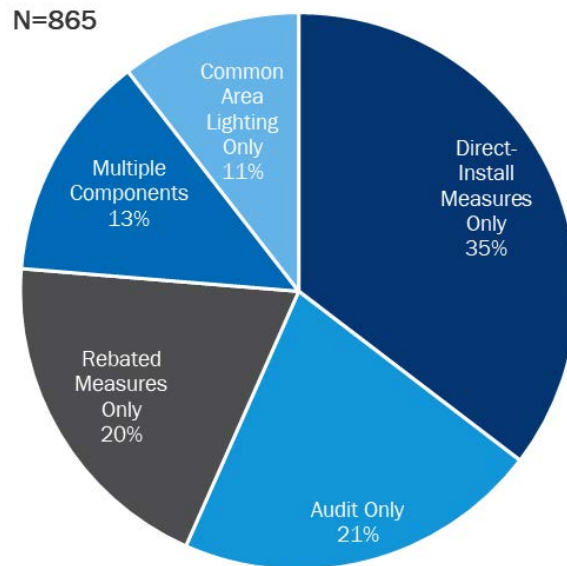
3.3 Participation & Marketing

In this section, the evaluation team characterizes program participation, explores the drivers of and barriers to participating in the rebated measures portion of the program, and assesses the most effective marketing strategies.

3.3.1 Participation Overview

From January 2017 through July 2018 the MFRT program engaged with 865 unique properties, at which it conducted 493 free energy audits, 703 DI measure projects, and administered rebates for roughly 509 deeper energy-saving retrofit projects. Figure 5 below summarizes participation by the various program components. Four in ten properties (44%) went beyond the free audit and DI measures, showing a significant level of engagement with the program. As mentioned in program staff interview findings, the one-time push for common area lighting projects made at the end of 2017 represents a substantial portion of all rebated projects completed by properties during 2017, with 35% of the 375 rebated upgrades at a property involving common area lighting, 91 of which were solely common area lighting.

Figure 5. MFRT Program Participation by Component



Although a property’s engagement with the MFRT program may span multiple program years and change over time, the evaluation team defined four ways that properties participated in the program during the evaluation period. Table 23 summarizes these distinct pathways and the participants that fall within each of the four groups. Participants in groups A and B are termed as ‘stalled participants’ (i.e., those who engage in the no-cost portion of the program, but do not participate in the rebate portion). Participants in groups C and D are termed ‘full participants’ because they not only received the no cost audit, but also went on to fully engage in the incentive-eligible portions of the program. An understanding of how the modes of engagement, motivations/interests and challenges vary between these stalled and full participants is critical for identifying ways to improve the program.

Table 23. Stalled versus Full Participants (2017 – Q2 2018)

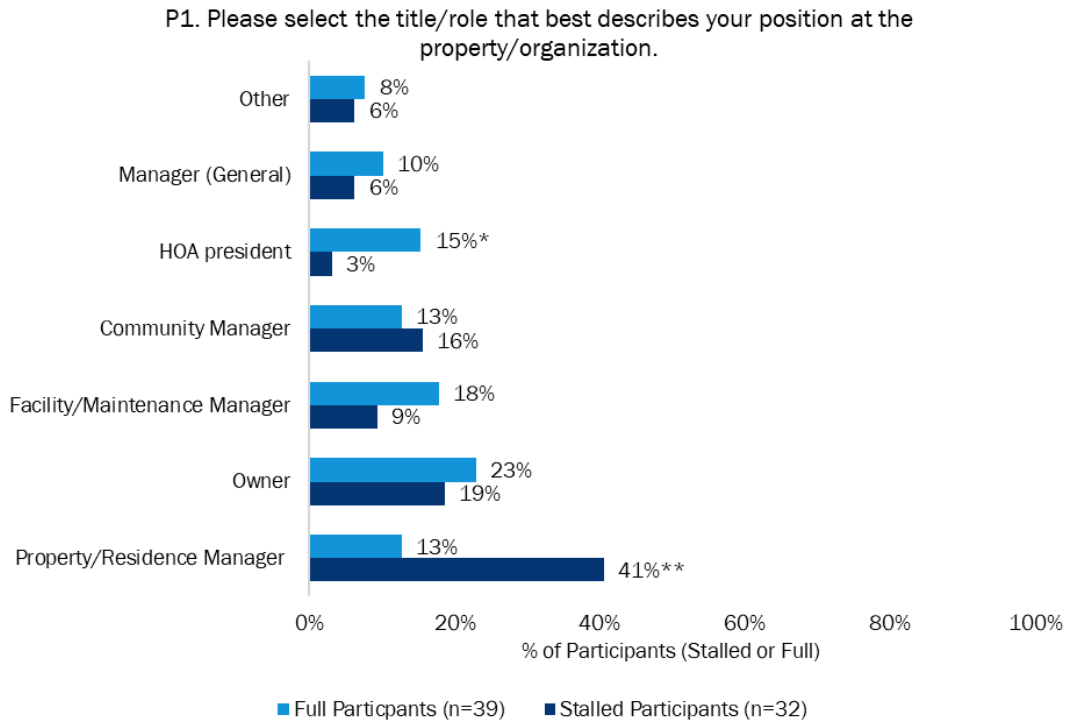
Participant Type	Count (by property)	%
Total Stalled Participants	484	56%
A. Stalled (audit only)	184	21%
B. Stalled (audit + DI only)	300	35%
Total Full Participants	381	44%
C. Full (audit + rebated measures only)	270	31%
D. Full (audit + DI + rebated measures)	111	13%
Total Participants	865	100%

3.3.2 Participant Characteristics

The management structure and the number of properties in each participant's portfolio varies widely. Over half of respondents (54%, n=38) both own and manage their property, while 37% (n=26) only manage the property. Additionally, respondents were asked about the number of properties they manage. Approximately half of respondents (48%, n=34) oversee 15 properties or less and one-fourth of this majority oversees only one property. This suggests that the MFRT program is capturing the smaller property management companies in addition to the larger corporate residential properties.

Most of the participants that interact with the program are associated with the title of "property manager". The evaluation team asked survey respondents to provide their job title and the large majority (>70%) in both groups said they were a manager of some kind (Figure 6). There were no statistically significant differences between any of the job titles held by the full participants versus the stalled participants apart from those identifying themselves as Home Owner Association (HOA) presidents and Property/Residence Managers. One possible explanation for the higher percentage of HOA presidents in the full participant group is the MFRT program requirement for HOAs to enlist a majority of members to participate in the MFRT program to qualify for the DI measure portion of the program. Another plausible explanation is that the program recently placed greater emphasis on targeting the condominium segment of the MF market (as revealed during program staff interviews). The high percentage of Property/Residence managers among stalled participants is likely related to their lack of authority and/or availability of financing managers (especially those that work for larger management companies) that property owners sometimes require to proceed beyond the no-cost DI portion of the program.

Figure 6. Job Title by Participant Type



*Indicates statistical significance at the 90% confidence level
 **Indicates statistical significance at the 95% confidence level

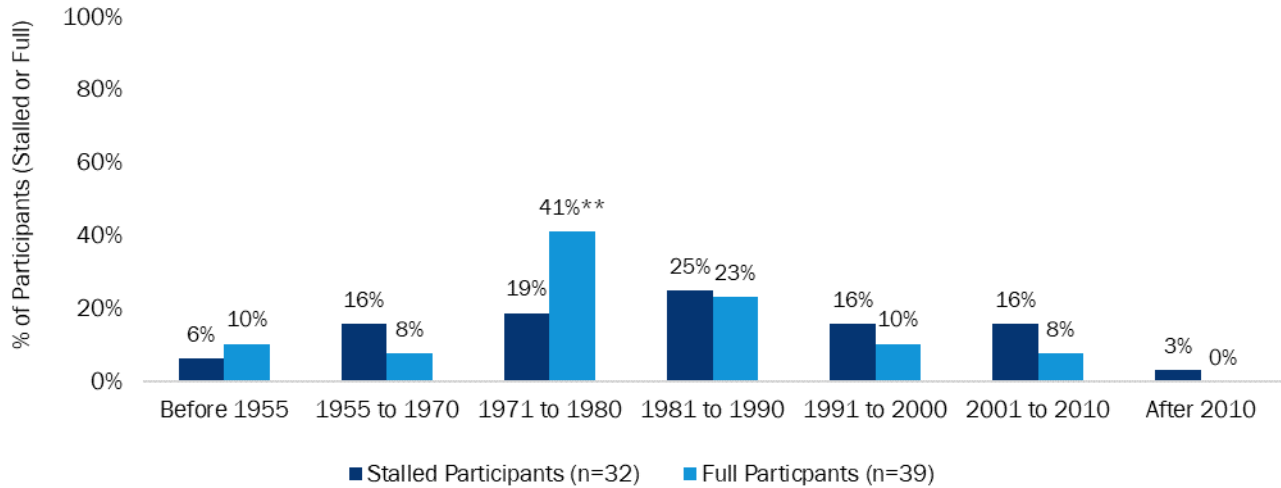
3.3.3 Property Characteristics

The evaluation team asked both full and stalled survey respondents about the age of their properties, using year ranges that coincided with major changes to Washington State Building Code. As shown in Figure 7, more than half of respondents reported a construction date between 1971 and 1990 (55%, n=39). Full participants reported a significantly higher proportion of properties built between 1971 and 1980 (41%, n=16 versus 19%, n=6). Given the adoption of a state-wide energy code in 1977, it is likely that properties built before this date were less energy efficient and therefore have a greater need for updated equipment.

Respondents were also asked about the heating and cooling systems used by the property. Close to three-fourths of respondents (73%, n=52) have no cooling system while all respondents have some type of heating system, the most common being individual heating units (85%, n=60). This indicates that the retrofit upgrade opportunities for this segment are focused around heating systems.

Figure 7. Age of Property by Participant Type

P8. When was this property built? If you are unsure, your best guess is fine.

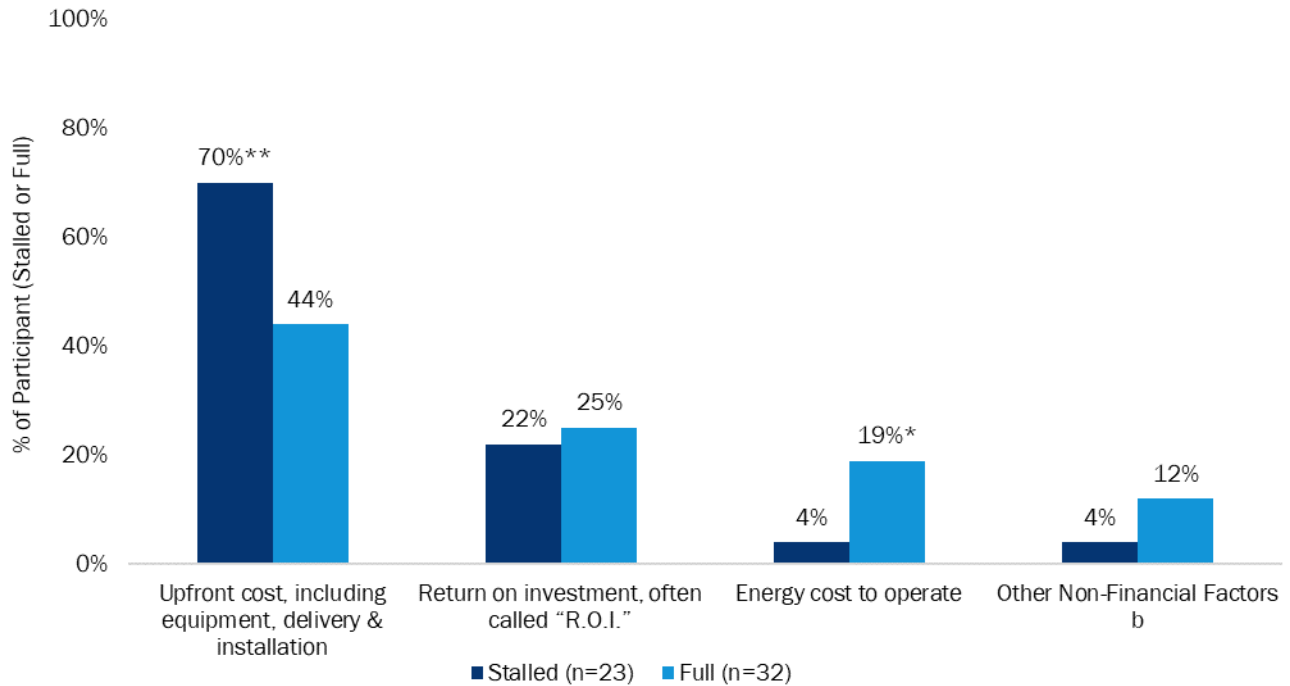


**Indicates statistical significance at the 95% confidence level

The evaluation team asked respondents questions to better understand the general decision-making structure for property upgrades and identify standard practice for equipment selection and operation. Respondents were first asked about various factors they consider when making upgrades. If a respondent selected more than one option for this question, they were then asked to select the main factor considered when making upgrades. Figure 8 displays the results of this follow-up question, comparing the answers of stalled and full participants. While the overall majority of participants identified the ‘upfront cost’ as the main factor considered (55%, n=30), stalled participants had a significantly higher percentage of participants (70% versus 44%) choosing this as the main factor. 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 possess a shorter-term decision calculus whereas full participants may be more likely to consider the longer-term costs. Given the trade-off between high upfront costs and lowered energy costs over the lifetime of energy efficient products, the upfront cost may serve as more of a barrier to stalled participants.

Figure 8. Decision-Making Factors by Participant Type

D7a. Of the factors you consider when purchasing new equipment, what would you say is the MAIN factor?^a



^a Respondents were only asked D7a if they chose more than one factor in question D7.

^b Other Non-Financial Factors include: 1) Quality, Durability and Appearance or 2) Delivery and Installation Factors (i.e., Speed and Convenience) or 3) Maintenance Factors (i.e., Upkeep Required, Warranties, etc.) or 4) Open-Ends.

*Indicates statistical significance at the 90% confidence level

**Indicates statistical significance at the 95% confidence level

Aside from the considerations discussed above, energy efficiency is also a priority for many respondents. When asked to rate the importance of energy efficiency of the equipment when thinking of upgrading or replacing energy-using equipment and other building improvements, only two respondents gave a rating less than 3 and approximately 50% selected 5-Very Important as the rating.

Respondents generally gave low scores for the influence of vacancy rates on purchasing decisions. While the majority found vacancy rates to be non-influential, there were 16 respondents who rated its influence at a 3 or higher and were asked to elaborate. Their explanations dealt mainly with the lack of access to capital when operating below 100% occupancy. As one respondent explained, *“When apartments are fully occupied, the cash flow is normally better, more room to accommodate specialty projects. When vacancy is high, income is lower than anticipated, normally projects get removed, reduced, or pushed out into the future.”*

3.3.4 Bridging the Gap Between DI and Rebated Measures

Using 2017 as the starting point, the evaluation team calculated a conversion rate that shows 35% of sites converted during this time period, although survey results and on-site depth interviews suggest that the rate is actually higher given the number of properties who received an audit or DI measures pre-2017 and then went on to receive a rebate in 2017 or 2018. In fact, only 171 of the 381 properties that completed rebated

projects in the tracking data can be taken into account for the calculated conversion rate, despite the fact that these participants have gone deeper into the program.

Survey results provide some insight into what the tracking data cannot, and they indicate that the gap between stalled and full participants (i.e., those who only engage in free DI measures versus those who go on to install rebated measures), is not substantial. Of the 32 stalled participants surveyed, 19 recall receiving rebate recommendations (the most frequent being common area lighting with 16 of 19 participants recalling the recommendation). Among those who recall receiving the recommended upgrades, 47% (n=9) had already installed the recommended upgrades at the time of the survey and another 16% (n=3) plan to install in the future. Such results overall align with what the team saw at the population-level.

As previously noted, over one-third of the population during the study period installed rebated equipment (n=275). The remaining participants received the audit and DI components within the last 18 months at most, and given the longer timelines associated with the more complex retrofits, it is too early to determine whether these properties will continue to be stalled participants in the program.

Said another way, many participants who appeared stalled in the program have either installed the recommended upgrades or intend to do so in the future. This finding is supported by discussions with property managers during site visits; most of the properties defined as stalled based on their participation in the study period had already received a rebated upgrade in 2016 or earlier (most commonly attic insulation or new windows), and three of the property managers said they had upgrades through the program in their 2018 budget plans. Of the 47% who are in the process of installing the recommended upgrades, the majority plan to through PSE's program (44%, n=4). The five participants who said they did not seek a rebate from PSE for all or some of the upgrades they installed either received the rebate through Seattle City Light or were under the impression that the project would not qualify (e.g., one participant said, "We didn't upgrade all windows and my understanding is you could only qualify for the rebate if you upgraded the entire property."). The seven participants who said there were no plans to install the recommended upgrades cited the following reasons: financial limitations (n=3), staff limitations (n=1), tenant-related concerns (n=2) and only replacing on an as-needed basis (n=1).

Despite the high conversion rate and the number of participants that plan on converting, there are some opportunities to bridge the gap that remain between full and stalled participants. When the team asked the seven participants with no plans to install the recommended upgrades what, if any, additional information would help them implement the measures, 57% (n=4) said they would need additional rebate eligible information to perform the upgrades. This finding is supported by discussions with property managers during site visits. For example, two of the property managers told the evaluation team that they were given only a one-page list of rebate eligible products, and this information lacked contractor quotes, the names of certified equipment vendors, or information about the reduction in utility bills the property could expect to see from such a rebate. For example, one site visit participant noted that his boss will never approve a project without more information.

The HOA segment of the MF market presents another opportunity. As survey results confirm, (see Appendix A) one would expect homeowner organizations to have a vested interest in increasing the value of their properties and therefore be more likely to invest in costlier retrofits. Although the program does not track property type at the population-level, HOA properties are thought to comprise a small portion of the overall program population (hence the program's push to engage this segment in recent years). Increasing the number of HOAs participating in the program would likely further boost the number of full participants. However, the current requirement for having to enlist a majority of owners to participate in the program

"PLEASE KEEP IT GOING EVERY YEAR! We love the program and hope to use it on future rehab projects."

-stalled survey respondent

before receiving the audit and DI poses a higher 'cost-of-entry' for this particular group. For example, several HOA survey respondents described going door-to-door to individually recruit members to the program. PSE could overcome this barrier by conducting direct outreach to HOAs. If PSE staff could present the benefits of MFRT at an HOA meeting (or similar condo association event) and recruit owners at that time, it would be easier to get these types of properties engaged with the program (instead of relying on pro-active and energy-conscious HOA members). Overall, the more streamlined the HOA enrollment process becomes, the greater this segment of participants will become which will likely lead to more participants going deeper into the program.

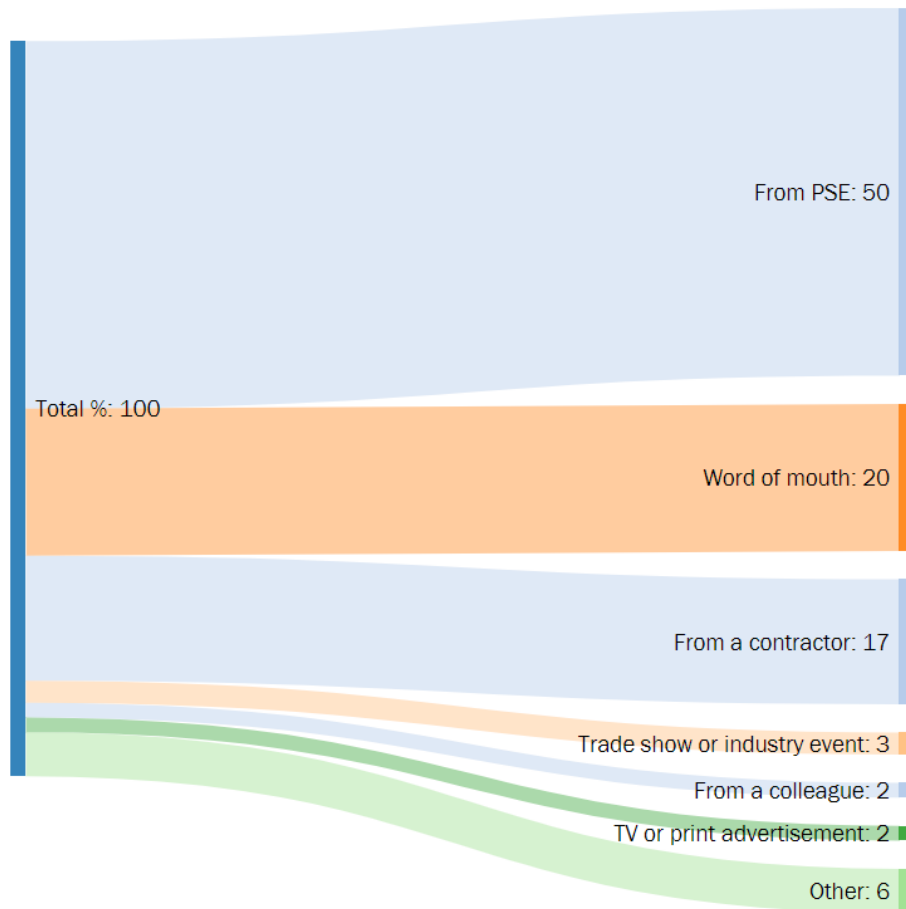
3.3.5 Marketing Strategy

Based on feedback from respondents to survey, PSE successfully reaches its MF participants through a variety of channels, particularly through emails, the PSE website, and communication through its other energy efficiency program offerings. In addition, marketing efforts for the MFRT program include television and digital media spots, print advertisements in trade journals, partnering with MF associations to generate energy efficiency leads, working with the Energy Efficient Communities team to develop and implement target outreach strategies for both business partners and customers, and communicating with property managers, owners, and tenants through quarterly e-newsletters. In addition, PSE holds Energy Fairs to recruit participants and raise awareness about the reduced amount of energy needed to operate the DI measures available through the program. PSE also uses the Energy Fairs as a participant engagement platform where PSE staff presents options for enhanced upgrades at the property while the implementer directly installs energy efficient measures in tenant units.

An additional marketing feature of the MFRT program is the "Strive for Five" campaign, where PSE and implementer staff award plaques and plates to MF properties that have taken advantage of several of the incentives available through the program. This campaign is designed to recognize those MF properties that show a commitment to energy efficiency by installing equipment from at least five different energy efficiency categories. "Strive for Five" additionally supports program objectives related to encouraging participants to go beyond DI opportunities and take advantage of the deeper rebated components of the program.

Figure 9 shows participant responses when asked about how they first heard about the MFRT program. Notably, when taken together, PSE-led marketing efforts are the primary channel through which participants first learn of the MFRT program. Specifically, PSE's website, emails, other energy-efficiency programs, Energy Fairs and TV/print advertisements are the channels through which over half of respondents first heard about the program. Contractor-led efforts were another important channel through which participants heard about the program, with approximately 17% of respondents hearing about the program through contractor recommendations and contacts.

Figure 9. Marketing Enrollment Channels for MFRT Participants*



*Seven respondents who indicated “Don’t Know” are excluded.

Respondents were also asked about their preferred method of receiving information from the program in the future. Over half of respondents (58%, n=41) said they would prefer to receive this information in an email that was separate from their utility bill, while 18% (n=13) said they would like it as information included with their utility bill and 11% (n=8) said they would like it in the mail but separate from their bill.

To better understand what participants are getting from the program (and to leverage such findings for future marketing efforts), respondents were asked about what benefits they have noticed since their property’s participation in the program. As noted in Table 24, reduced utility bills, increased tenant satisfaction and comfort, and reduced maintenance costs were the top benefits identified by participants. To further increase MF customer engagement, program marketing efforts going forward should incorporate messaging related to such benefits.

Table 24. Participants’ Self-Reported Program Benefits

What benefits have you noticed since your property’s participation in the program? Responses	% of Total Responses* (n=70)
Reduced Utility Bills	56%
Increased Tenant Satisfaction	41%
Increased Tenant Comfort	34%
Reduced Maintenance Costs in Terms of Expenses	30%
Reduced Maintenance Costs in Terms of Labor Hours	19%
More Attractive Property for New Tenants	17%
Don't Know	11%
No benefits noticed	10%
Reduced Tenant Turnover	3%
Other (Still Trying to Determine If It Has Helped Financially)	1%

*Question 04 was a multiple response question. Percentages are expressed in terms of total answering question and therefore do not sum to 100%. One respondent was dropped for non-categorical open-end response under the “Other” option.

3.3.6 Serving Hard-To-Reach Customers

Exploring Customer Outreach Across Population Demographics

MFRT program staff identified a challenge with assessing how well the program is currently reaching underserved communities and how they might better reach such communities in the future. To address this need, the evaluation team developed a GIS tool that analyzes the spatial distribution of MFRT participants during the study period against population demographics using U.S. Census data at the block group level.¹⁶ In addition to MF properties and low-to-moderate income (LMI) households defined as HTR communities in The Northwest Power and Conservation Council’s 7th Power Plan, the evaluation team also looked at the percentage of households whose primary language is Spanish (as this was also identified as an underserved community in the BCP). The maps and screenshots below are intended as a proof-of-concept guide that demonstrates how PSE can use the tool for precise customer targeting at the city/town/neighborhood level, thereby enabling the MFRT program to better target underserved communities in the future.

Figure 10 first presents a map of the geocoded MFRT participants from January 1, 2017 to July 31, 2018 in PSE’s service territory. Figure 11 presents portions of that same map, but on a smaller scale and focused on the cities of Mount Vernon and Burlington in Skagit County. Maps 1, 2 and 3 in Figure 11 show the distribution of three different types of Census data at the block group-level across the towns: income (percentage of households living at or below the 150% poverty level¹⁷), MF properties (percentage of residential structures with multiple attached units), and Spanish speakers (percentage of households that speak only Spanish, mainly Spanish with limited English or dual-language with Spanish preferred). In Map 1,

¹⁶Census data comes from the most recent [5-year estimates of the American Community Survey](#) (released in December 2017). Estimates at the block group-level are only released every five years but are the most reliable estimates and are best-suited for analyzing smaller populations at the neighborhood-level since they represent the smallest geographic unit of analysis (no more than 3,000 households per block group).

¹⁷ Calculated based on number of households with an annual inflation-adjusted income less than or equal to \$37,000 (150% poverty-level for an average family based on [2018 Federal Poverty Guidelines](#))

red and orange block-groups represent the highest percentages of households living at or below the 150% poverty level. In Maps 2 and 3, darker colors imply higher concentration of MF residential units and Spanish speaking households, respectively. Map 4 highlights the block groups with the highest concentration of the three census demographics, and with relatively few participating properties from the current study period. The block groups highlighted in Map 4 show potential areas where PSE could focus targeted MFRT program marketing efforts such as mail campaigns, energy fairs or neighborhood blitzes, all of which are more cost-effective when completed on a smaller, targeted scale. This is just one example of how PSE could use the GIS tool to develop customized marketing and customer outreach efforts for the MFRT program.

Figure 10. MFRT Participant Map

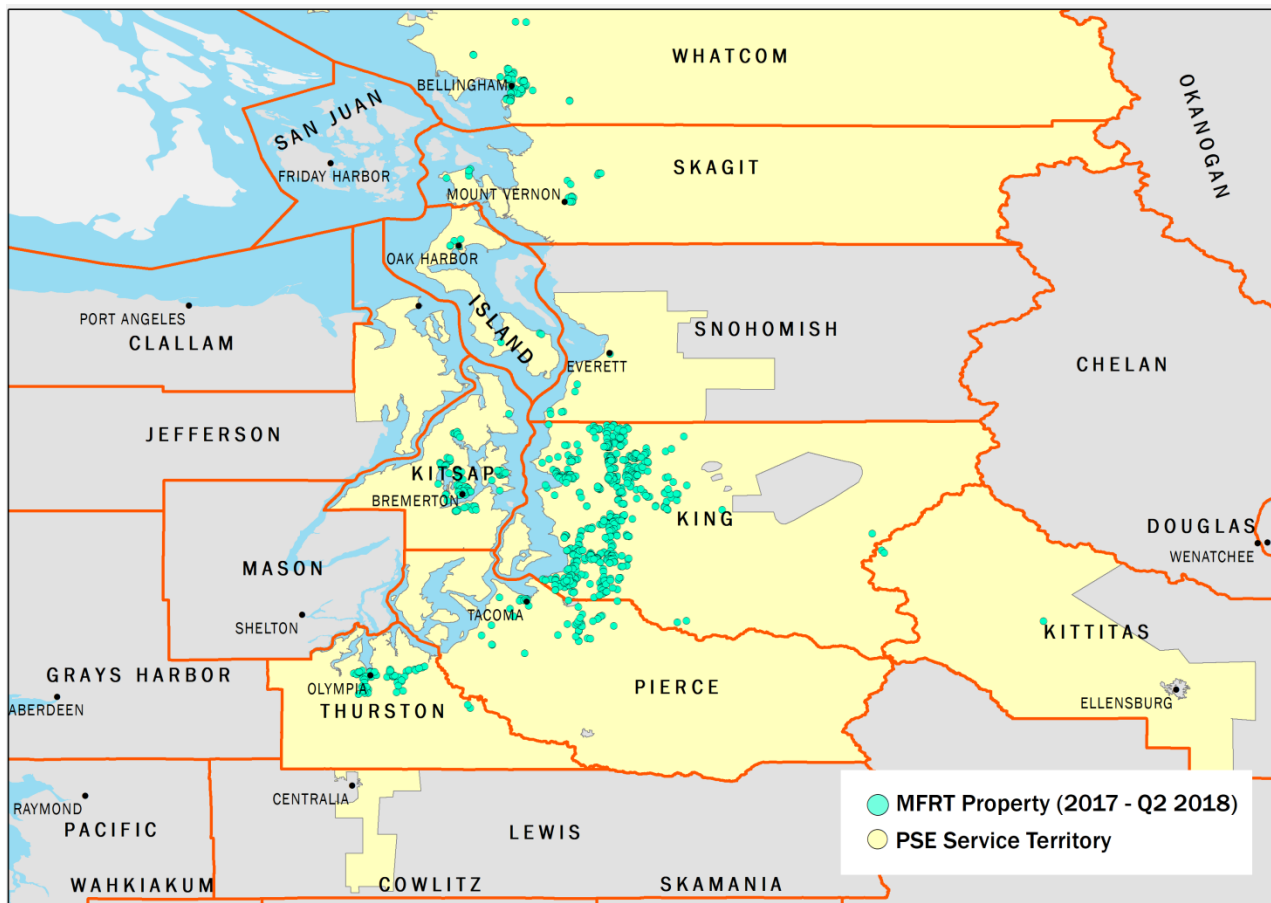
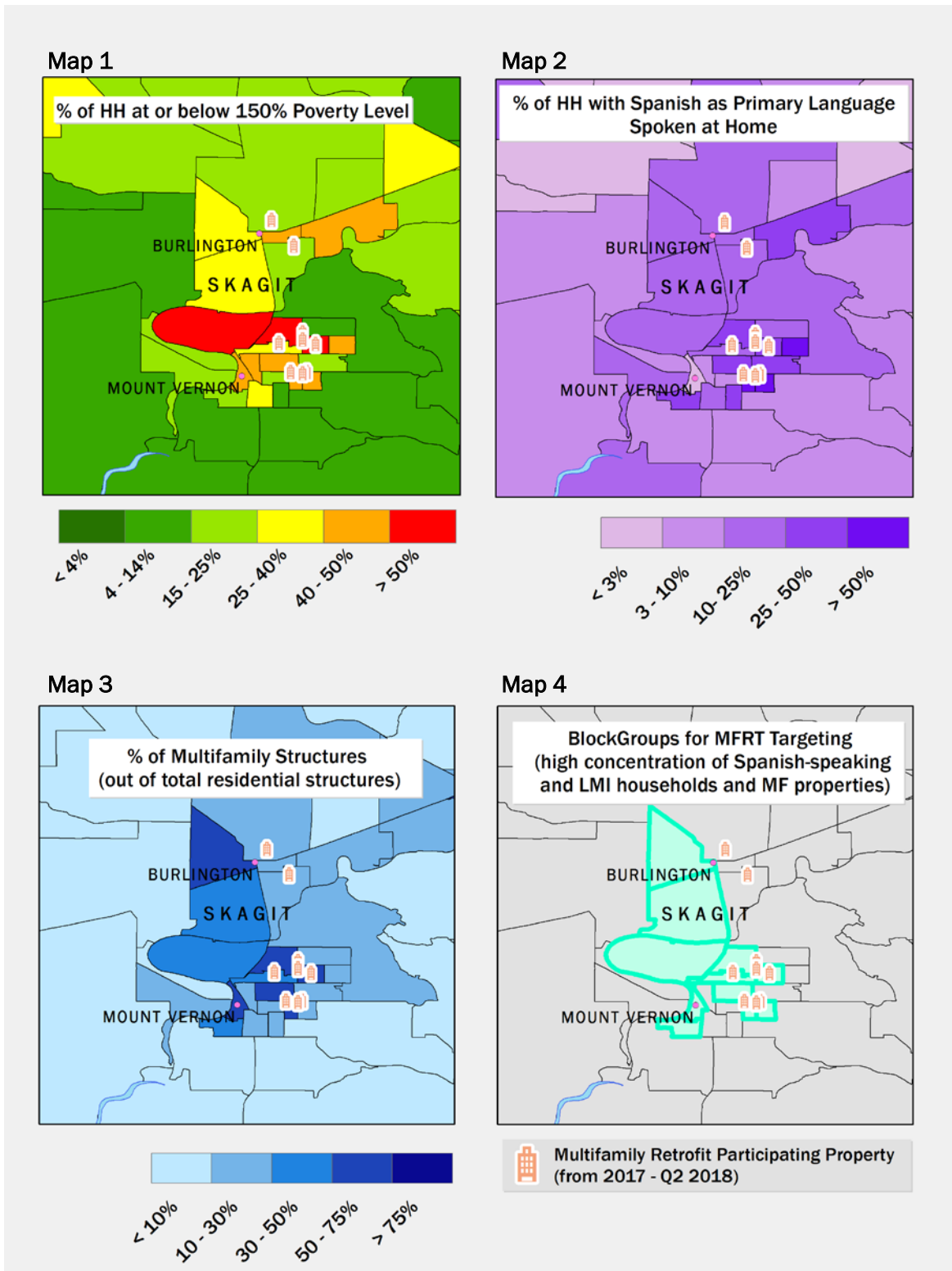


Figure 11. MFRT Participant Targeting with GIS Tool: Skagit County



3.4 Energy Savings

This section describes the activities undertaken to arrive at the 2017 MFRT program estimated gross electric and gas impacts, as well as the electric and gas savings realization rates.

After examining the program tracking data to determine how well the PSE tracking database aligns with the assumptions and algorithms documented in applicable program materials and other relevant sources (e.g., SoS Database, RTF), the team assessed the application of deemed savings within the database, identified errors, if any, and verified that the applied deemed savings resulted in the total reported savings provided in the program tracking database (see Section 3.2.3). Then the team reviewed the deemed savings application for deemed measures and found the following:

- **Energy to gas savings conversion for water conservation measures.** Reported gas savings for thermostatic restrictor adapters, showerheads, and showerheads with thermostatic restrictor adapters are under-estimated by converting a weighted kWh savings to therms, resulting in therm realization rates greater than 100%. PSE converts the electric RTF deemed savings value to gas using the electric kWh savings for “any” water heating fuel type when the tracking database indicates gas water heater. Instead, the electric RTF deemed savings for electric should be converted to therms instead of the RTF kWh savings for “any” water heater type.
- **Gas heating equipment assumptions for weatherization measures.** The reported gas savings for weatherization measures (e.g., insulation, windows, etc.) are under-estimated, resulting in therm realization rates greater than 100% by converting the kWh savings to therms for zonal heating. PSE converts the electric RTF deemed savings value to gas using the deemed values for electric zonal heating. The RBSA states that the majority of apartment units with gas heating use central heating equipment (e.g., forced air furnace), and therefore the evaluation team instead converted the RTF deemed electric savings for forced air furnaces.
- **Attic insulation (R-11 to R-38) deemed savings.** The reported gas savings are under-estimated resulting in therm realization rates greater than 100%. The RTF does not provide a deemed savings value for R-11 to R-38 attic insulation. It instead includes deemed values for R-0 to R-18 and R-19 to R-38. As a result, the evaluation team calculated the average savings per R-value using the values provided in the RTF and multiplied it by the increase in R-value ($\Delta 27$) going from R-11 to R-38.

Table 25 summarizes the differences in per-measure savings based on the differences in savings assumptions detailed above. Please note that the table only includes measures within the representative sample and therefore some offered program measures are not listed in the table.

Table 25. Deemed Savings Differences (Reported vs. Evaluated)

Measure	Units	Reported kWh/Unit	Evaluated kWh/Unit	Reported Therms/Unit	Evaluated Therms/Unit
Thermostatic Restrictor Adapter Only (Gas WH)	Adapters	N/A	N/A	1.30	2.15
Thermostatic Restrictor w/ Showerhead (Gas WH)	SHs	N/A	N/A	8.50	13.57
Attic Insulation - R-11 to R-38 (Elec Htg)	SF	0.56	0.64	N/A	N/A
Attic Insulation - R-11 to R-38 (Gas Htg)	SF	N/A	N/A	0.02	0.03
Window - Double Pane U-0.30 (Elec Htg)	SF	12.80	10.05	N/A	N/A
Window - Double Pane U-0.30 (Gas Htg)	SF	N/A	N/A	0.96	1.08

The evaluation team then performed a total of 60 desk reviews. Evaluated savings for measures installed in 25 properties relied solely on desk review findings, whereas the remaining 35 properties relied on findings from both desk reviews and site visits. Table 26 summarizes the total reported and evaluated savings for measures that solely rely on results from the desk reviews and shows that the difference between reported and evaluated savings is less than 2% for electric savings and 0.10% for gas savings.

Table 26. Evaluated Savings from MFRT Desk Reviews

	n*	Reported Savings	Evaluated Savings	Difference
kWh	19	2,359,975	2,396,922	+ 36,947
Therms	7	7,123	7,116	- 7

*Totals to more than the 25 completed desk reviews since one property received both electric and gas service from PSE and are thus represented in both the kWh and therm categories.

The differences in savings stem from discrepancies in lighting assumptions, including:

- **Efficient wattages vary from project documentation.** Reported savings apply different efficient wattages than what is presented in the actual installed product specifications. The evaluation team applies the wattages provided in the specification sheets.
- **Energy savings factor for lighting controls.** Reported savings apply a custom energy savings factor that ranges from 15% to 25%, where the evaluated savings applies the energy savings factor presented in the RTF, ranging from 25% to 50%, thus resulting in an increase in energy savings.

The team then conducted site visits with a sample of properties. Table 27 summarizes the total reported and evaluated savings for all measures installed in the sampled 35 properties. The resulting persistence rates from the site visits are embedded in the measure savings and are accounted for in the savings summarized below.

Table 27. Evaluated Savings from Site Visits

	n*	Reported Savings	Evaluated Savings	Difference
kWh	27	2,577,179	2,389,561	- 187,617
Therms	10	7,515	8,228	+713

*Totals to more than the 35 completed site visits since two properties receive both electric and gas service from PSE and are thus represented in both the kWh and therm categories.

The differences in savings stem from discrepancies in savings assumptions, specifically from low persistence rates for power strips. Reported savings for power strips account for approximately 14% of the program’s overall savings. Since site visit results revealed low persistence rates for power strips (19%) the implications on the evaluated energy savings is evident, thus resulting in decreased energy savings.

Finally, the evaluation team compiled the total evaluated savings from the deemed savings application, desk reviews, and site visits and compared them to the total reported savings for the 60 sampled properties. The total reported and evaluated savings for the sampled properties are summarized below in Table 28.

Table 28. Evaluated Savings for Sampled Properties (n=60)

Fuel Type	N	n	Reported Sampled Savings		Evaluated Sampled Savings	
			kWh	Therms	kWh	Therms

Fuel Type	N	n	Reported Sampled Savings		Evaluated Sampled Savings	
Electric	445	43	4,536,602	-	4,425,703	-
Gas	72	14	-	14,156	-	14,689
Combo	23	3	400,552	481	360,780	654
Total	540	60	4,937,154	14,637	4,786,483	15,344

The evaluation team used the ratio adjustment method¹⁸ to extrapolate evaluated savings results for the sampled properties back to the overall 2017 population. The sampling and results calculation approach varies by the PSE service (e.g., electric, gas, combo) provided to each property. For properties where PSE provides both electric and gas (combo), the evaluation team performed simple random sampling (SRS) and calculated savings estimates, ratios, standard error, confidence intervals, and precision appropriate to that sampling approach. For properties where PSE provides either electric or gas, the evaluation team used a stratified random sampling approach and calculated ratios and associated statistics using a stratified ratio estimator-combined method. Appendix B and Appendix C provide details describing the methods for calculating each ratio (i.e., realization rates) using both the SRS and stratified sampling methods. Table 29 identifies these realization rates for each PSE service type provided to the sampled properties.

Table 29. Evaluated Realization Rates

Fuel Type	Realization Rate	
	kWh	Therms
Electric	94%	N/A
Gas	N/A	107%
Combo	90%	135%
Total	94%	112%

The overall evaluated program savings were calculated by applying the realization rates calculated using the appropriate sampling approach described above (and detailed in Appendix B and Appendix C) to the reported savings. Table 30 summarizes the evaluated realization rates and the resulting evaluated program savings, to which overall program realization rates of 94% and 112% for electric and gas were applied, respectively.

Table 30. Total Program Evaluated Savings

Fuel Type	Reported Savings		Ex-Post Savings		Realization Rate	
	kWh	Therms	kWh	Therms	kWh	Therms
MFRT Savings						
Electric	16,549,528	-	15,567,671	-	94%	N/A
Gas	-	24,874	-	26,609	N/A	107%
Electric & Gas (Combo)	1,112,001	5,662	1,001,276	7,658	90%	135%
Subtotal	17,661,529	30,536	16,568,947	34,268	94%	112%
MFAR Savings						
All	351,545	-	351,545	-	100%	N/A
Total	18,013,074	30,536	16,920,492	34,268	94%	112%

¹⁸ Levy, P.S. and Lemeshow, S. 2008. *Sampling of Populations: Methods and Applications* (4th Ed). Hoboken: John Wiley & Sons, Inc.

Achieved Precision for Program Savings

The team designed the representative sample with an overall program goal of 90% confidence and $\pm 10\%$ precision. This means that, in theory, if we were to repeat the evaluation multiple times, 90% of the time we would achieve results that are within $\pm 10\%$ of the ex post savings achieved in 2017. The team implemented two sampling designs (e.g., stratified, simple random) to sufficiently represent the 2017 MFRT population due to the availability, or lack thereof, of sites receiving both electricity and gas from PSE. After extrapolating to the population for each sample design method, the team calculated the program-level relative precision for electric and gas. Table 31 shows that the sample achieved better than $\pm 10\%$ precision at 90% confidence level, performing better than designed and demonstrating statistically sound results.

Table 31. Program Level Achieved Relative Precision

	kWh	Therms
Realization Rate	94%	112%
Confidence	90%	90%
Relative Precision	+/-5%	+/-7%

Appendix A. MFRT Process Evaluation: Detailed Survey Results

In partnership with Puget Sound Energy (PSE), Opinion Dynamics conducted a survey of participants in PSE's Multifamily Retrofit (MFRT) program. The survey was fielded from October 15 - 31, 2018 and resulted in 71 completes from property managers who participated in the MFRT program between January 1, 2017 and July 31, 2018. The survey sought to gain feedback on the participant's experience, satisfaction and suggested areas of improvement. Amongst full participants (participants who installed rebated equipment through the program), the survey gained feedback on the decision-making around installing rebated measures through the program. Amongst stalled participants (participants who received an audit only or received an audit and free DI measures), the survey explored awareness of rebated measure options, likelihood of rebated measure installation in the future and barriers to installation. To this end, the survey was focused on answering the following research questions in the evaluation plan for this program:

- What marketing efforts were most effective in reaching participants?
- How do tenants and property managers experience the program and how can it be improved from their perspective?
- How is the program influencing customer decision-making for energy efficiency improvements in MF properties?

Survey Structure

Table 32 summarizes the survey structure, participant types, and research objectives/topics by section.

Table 32. MFRT Participant Survey Sections

Survey Section	Participant Type	Purpose of Section
Screener	All Participants (A, B, C & D)	<ul style="list-style-type: none"> Introduces survey purpose and confirms that the respondent recalls participating in the program at the address on record Terminates customers who do not recall participation from the survey
Property Characteristics		<ul style="list-style-type: none"> Collects information on property characteristics to inform our impact analysis Gather firmographics to understand context of decision making
Decision-Making		<ul style="list-style-type: none"> Addresses property management decision making structure for property upgrades Identifies standard practice for equipment selection and operation
Overall Program Experience		<ul style="list-style-type: none"> Identifies marketing efforts that are successful in reaching participants and factors driving program enrollment
Energy Audit: Experience and Satisfaction		<ul style="list-style-type: none"> Gauges building audit's impact on respondent's awareness of energy efficient upgrades Gathers data about satisfaction with experience of audit portion of MFRT program Identifies attribution of the audit on later actions
Direct Install (DI) Measures: Experience and Satisfaction	Participants B & D	<ul style="list-style-type: none"> Verifies measures received based on tracking data records (if no onsite visit) Reviews free measures received Gathers data about satisfaction with experience of direct-install (DI) portion of MFRT program Identifies attribution and influence of the DI portion on later actions
Rebated Measures: Experience and Satisfaction / Interest and Barriers	Participants C & D	<ul style="list-style-type: none"> Verifies measures received based on tracking data records (if no onsite visit) Reviews services received Gathers data about satisfaction with experience of rebated-measure portion of the program Identifies attribution and influence of rebates on later energy efficient upgrades Identifies program components that were successful in encouraging participation in the rebate-eligible upgrades
Rebated Equipment: Interest and Barriers	Participants A & B	<ul style="list-style-type: none"> Identifies barriers to participation in the rebate-eligible upgrades Identifies customers that plan to invest in a rebate eligible upgrade later Asks how the program could be improved moving forward Asks what PSE or the program could do to change their mind
Overall Program Satisfaction	All Participants (A, B, C & D)	<ul style="list-style-type: none"> Gathers data about satisfaction with overall experience of MFRT program

Survey Respondents Overview

The table below summarizes the total survey completes by participant type.

Participant Type	Count	Percentage
A. Stalled (audit only)	8	11%
B. Stalled (audit + direct install only)	24	34%
Total Stalled Participants	32	45%
C. Full (audit + rebated measures only)	23	32%
D. Full (audit + direct install + rebated measures)	16	23%
Total Full Participants	39	55%
Total Participants	71	100%

Survey Results Topline

These topline tallies the responses by survey questions and, where appropriate, compares responses across participant type. For responses that show statistical differences across participant type, a letter is placed next to the result within the topline tables.

Property Characteristics

P1. Please select the title/role that best describes your position at the property/organization.

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Other	4	2	2
	6%	6%	5%
Property/Residence Manager	18	13	5
	25%	41% (F)	13%
Manager General	6	2	4
	8%	6%	10%
Community Manager	10	5	5
	14%	16%	13%
Owner	15	6	9
	21%	19%	23%
Assistant Manager	1	0	1
	1%	0%	3%
Facility/Maintenance Manager	10	3	7
	14%	9%	18%
HOA President	7	1	6
	10%	3%	15% (s)

Open-End for Customers who marked “Other” for P1 (Verbatim):

- *Regional Manager*
- *Green Team Project Manager*
- *Executive Director*
- *Maintenance Tech*

P2. Is your company a for profit or non-profit organization?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
For Profit	37	19	18
	52%	59%	46%
Non-Profit	34	13	21
	48%	41%	54%

[ASK IF P2=01]

P2ab. Please select the option that best describes the business structure of the property. If your multifamily property does not fully fit into one of the categories listed below, please explain in the space provided.

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Other	1	0	1
	1%		3%
Home Owners Association or Condominium Association	25	9	16
	35%	28%	41%
Property Management And/or Real Estate Development Corporation	14	9	5
	20%	28%	13%
Privately-Owned/Family-Owned Business	17	8	9
	24%	25%	23%
Senior Living Facility	6	4	2
	8%	13%	5%
Governmental Organization I.E., Public Housing Agency	3	0	3
	4%		8%
Non-Profit Organization	3	1	2
	4%	3%	5%
Prefer Not to Say	2	1	1
	3%	3%	3%

Open-End for Customer who marked "Other" (Verbatim):

- *Limited Partnership*

P3. Does your organization own the property at <ADDRESS_SHORT>, manage it, or both own and manage it?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Own and Manage	38	18	20
	54%	56%	51%
Manage Only	26	11	15
	37%	34%	38%
Own Only	6	3	3
	8%	9%	8%
Don't Know	1	0	1
	1%		3%

[ASK IF P3=01,03]

P3a. Please select the option that best describes what you and/or your organization intend to do with the property at <ADDRESS_SHORT> in the future.

Response	Total (T)	Stalled (S)	Full (F)
Total Answering	41	20	21
Don't Know	7	4	3
	17%	20%	14%
We Plan to Sell the Property Within the Next Five Years	1	0	1
	2%		5%
We Have No Plans to Sell the Property in the Next Five Years, but We May Consider Selling it at Some Point in the Distant Future	12	6	6
	29%	30%	29%
We Never Intend to Sell the Property	19	9	10
	46%	45%	48%
Other	2	1	1
	5%	5%	5%

Open-End for Customers who marked “Other” (Verbatim):

- We have 11 owners of 11 condos in our building
- We're a condo assn. Members sell and go and buy and come.

P4. How many properties does your organization own or manage? If you are unsure, your best guess is fine. [NUMERICAL OPEN END]

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
0	1	0	1
	1%		3%
1	17	4	13
	24%	13%	33% (S)
2 to 15	17	10	7
	24%	14%	10%
16 to 50	22	14	8
	31%	20%	11%
More than 50	14	4	10
	20%	6%	14%

P5. Are the tenants at <ADDRESS_SHORT> responsible for paying their own electric and/or gas utility bills, or are utilities included in the rent?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Other (HUD Low-Income Energy Credit)	1	1	0
	1%	3%	
Tenants Pay Their Own Gas and/or Electric Bills	48	18	30
	68%	56%	77% (s)
Gas and/or Electric Utilities are Included in the Rent	7	3	4
	10%	9%	10%

Tenants Pay Some Utilities While Others are Included in Rent (e.g., Gas Included)	14 20%	9 28%	5 13%
Don't Know	1 1%	1 3%	0

P8. When was this property built? If you are unsure, your best guess is fine.

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Before 1955	6 8%	2 6%	4 10%
1955 to 1970	8 11%	5 16%	3 8%
1971 to 1980	22 31%	6 19%	16 41% (S)
1981 to 1990	17 24%	8 25%	9 23%
1991 to 2000	9 13%	5 16%	4 10%
2001 to 2010	8 11%	5 16%	3 8%
After 2010	1 1%	1 3%	0

P9. When thinking about the income levels of the tenants at this property, which of the following characterizes the tenants best?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Mostly Low Income	14 20%	8 25%	6 15%
Mostly Middle Income	19 27%	7 22%	12 31%
Mostly High Income	6 8%	1 3%	5 13%
Somewhat Diverse, with Low and Middle-Income Tenants	13 18%	6 19%	7 18%
Somewhat Diverse with Middle and Upper Income Tenants	11 15%	6 19%	5 13%
Very Diverse with Low, Middle, and Upper Income Tenants	2 3%	2 6%	0
Don't Know	6 8%	2 6%	4 10%

P10. Does this property have a centralized heating system or individual systems within units?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Centralized	6 8%	1 3%	5 13%
Individual	60 85%	29 91%	31 79%

Both Centralized and Individual Systems	5	2	3
	7%	6%	8%

P11. Does this property have a centralized cooling system or individual units?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Centralized	4	2	2
	6%	6%	5%
Individual	12	3	9
	17%	9%	23%
Both Centralized and Individual Systems	3	0	3
	4%		8%
No Cooling System	52	27	25
	73%	84% (F)	64%

Decision-Making

D1. When you need to make purchasing decisions for the property, are you usually the only person involved in the decision or are others involved?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Only Person	8	3	5
	11%	9%	13%
Others Involved	33	13	20
	46%	41%	51%
Depends on the Situation	30	16	14
	42%	50%	36%

[ASK IF D1=02, 03]

D2-D4. Please elaborate on the role of additional decision-makers by filling in the chart below.

D2. Is anyone other than yourself involved in purchase decision?

Response	Count		
	Total (T)	Stalled (S)	Full (F)
Total Answering	63	29	34
Building Envelope Upgrades	46	18	28
	73%	62%	82% (s)
Energy Efficient Appliances	30	13	17
	48%	45%	50%
Lighting for Common Areas	42	16	26
	67%	55%	76% (s)
Thermostats	25	10	15
	40%	34%	44%
Energy Efficient Water Heating Upgrades	31	12	19
	49%	41%	56%
Energy Efficient Space Heating Upgrades	30	11	19
	48%	38%	56%
Other	4	3	1
	6%	10%	3%

Open-End for Customers who marked “Other” (Verbatim):

- *Varies*
- *Our Board of the Condo Association*
- *all major maintenance and repair must be approved by the board and membership*
- *all expenses not included in the budget*

D3. Do you need additional authorization past a certain dollar amount? D4. Dollar Amount (\$)

Response	D3. Count			D4. Average Amt (\$)		
	Total (T)	Stalled (S)	Full (F)	Total (T)	Stalled (S)	Full (F)
Total Answering	63	29	34	63	29	34
Building Envelope Upgrades	32 51%	16 55%	16 47%	\$ 33,203	\$ 7,663	\$ 58,744
Energy Efficient Appliances	18 29%	8 28%	10 29%	\$ 2,395	\$ 2,375	\$ 2,410
Lighting for Common Areas	20 32%	10 34%	10 29%	\$ 12,881	\$ 3,351	\$ 22,410
Thermostats	13 21%	7 24%	6 18%	\$ 2,954	\$ 2,614	\$ 3,350
Energy Efficient Water Heating Upgrades	22 35%	10 34%	12 35%	\$ 24,018	\$ 9,980	\$ 35,717
Energy Efficient Space Heating Upgrades	25 40%	12 41%	13 38%	\$ 5,184	\$ 8,400	\$ 2,215
Other	4 6%	3 9%	1 3%	\$ 7,750	\$ 10,000	\$ 1,000

D7. In general, when deciding on what type of energy-using equipment to purchase for the property, what factors does your organization consider? Please select all that apply. **[MULTIPLE RESPONSE UP TO 3]**

Response	Count and % of Total Answering		
	Total (T)	Stalled (S)	Full (F)
Total Answering	71	32	39
Upfront Cost, Including Equipment, Delivery and Installation	58 82%	25 78%	33 85%
Maintenance Cost	50 70%	23 72%	27 69%
Non-Financial Delivery and Installation Factors (I.E., Speed and Convenience)	16 23%	4 13%	12 31% (s)
Non-Financial Maintenance Factors (I.E. Upkeep Required, Warranties Etc.)	30 42%	13 41%	17 44%
Other Non-Financial Factors (I.E., Quality, Durability and Appearance)	37 52%	15 47%	22 56%
Energy Cost to Operate	48 68%	20 63%	28 72%
Return on Investment, Often Called "R.O.I."	43 61%	17 53%	26 67%
Other, Please Describe (Verbatim: I Decide for My Own Condo, Considering All Factors.)	1 1%	1 3%	0

[ASK IF MORE THAN 1 OPTION CHOSEN FOR D7]

D7a. Of the factors you consider when purchasing new equipment, what would you say is the MAIN factor?
 [LIST OPTIONS SELECTED FROM D7]

Response	Count and % of Total Answering		
	Total (T)	Stalled (S)	Full (F)
Total Answering	55	23	32
Other (Verbatim: I Decide for My Own Condo, Considering All Factors.)	1 2%	0	1 3%
Upfront Cost, Including Equipment, Delivery & Installation	30 55%	16 70% (F)	14 44%
Non-Financial Delivery and Installation Factors I.E., Speed and Convenience	1 2%	0	1 3%
Non-Financial Maintenance Factors (i.e., Upkeep Required, Warranties etc.)	1 2%	0	1 3%
Other Non-Financial Factors (i.e., Quality, Durability and Appearance)	2 4%	1 4%	1 3%
Energy Cost to Operate	7 13%	1 4%	6 19% (s)
Return on Investment, Often Called ROI	13 24%	5 22%	8 25%

D8. How much of an influence do vacancy rates (i.e., the proportion of unoccupied units) have on your decision to install energy efficient equipment?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
1 - Not at All Influential	34 48%	18 56%	16 41%
2	7 10%	1 3%	6 15% (s)
3	8 11%	5 16%	3 8%
4	5 7%	1 3%	4 10%
5 - Very Influential	3 4%	1 3%	2 5%
Don't Know	14 20%	6 19%	8 21%
Average Rating	1.88	1.69	2.03

[ASK IF D8 = 03,04,05]

D8a. Please explain how vacancy rates influence your decision-making. [OPEN-END]

Customer Feedback from D8a (Verbatims):

- In times of high vacancies, energy efficient amenities can draw prospective clients to the property
- when apartments are fully occupied, the cash flow is normally better, more room to accommodate specialty projects. When vacancy is high, income is lower than anticipated, normally projects get removed, reduced, or pushed out into the future.
- Need to upgrade for new tenants

- if we have low vacancy rates, we slow our spending
- At 100 % we are more apt to do improvements
- Mainly it would dictate when we would make upgrades.
- Full vacancy means more money for the property
- When we have 100% occupancy, it allows us the leeway to spend on projects (lighting upgrade, new refrigerators, etc.) When we're at 75% occupancy, we're not able to generate enough capital to spend on extra projects.
- Overall operating capital
- we are more apt to commit to purchases when vacancy is low.
- Market trends show that tenants prefer green/energy efficient products. In addition to the energy savings, it can be used for marketing. If vacancy rates are low, we might look to install more. Then again, it's a cost issue.
- Higher vacancy translates to lower NOI which means ownership is less likely to invest in energy efficiency programs.

D9. How important is the energy efficiency of the equipment when you are thinking of upgrading or replacing energy-using equipment and other building improvements?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
1 - Not at All Important	1 1%	0	1 3%
2	1 1%	0	1 3%
3	10 14%	5 16%	5 13%
4	19 27%	5 16%	14 36% (S)
5 - Very Important	34 48%	19 59% (F)	15 38%
Don't Know	6 8%	3 9%	3 8%
Average Rating	4.29	4.48	4.14

D10. Does your decision-making process differ for upgrades of energy-using equipment in common areas versus tenant areas?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Yes	24 34%	10 31%	14 36%
No	47 66%	22 69%	25 64%

[ASK IF D10=01]

D10a. Please describe how your purchasing decisions vary based on upgrades made in common versus tenant areas. [OPEN-END]

Customer Feedback from D10a (Verbatims):

- *Many of the residents pay their own utility bills and the bills are relatively low.*
- *Common area expense is covered by owner's cost. As where tenants normally pay for their own utility expense.*
- *Board of Director responsible for common areas only*
- *Like to try things out on the common area before installing in resident homes.*
- *common area is based on an HOA budget. tenant areas are individual owner decisions.*
- *Overall cost to operate the common area*
- *Common fully controlled by HOA, walls in controlled by individual unit owners*
- *individual condo owners make their own decisions in their own units*
- *Common areas are covered by the HOA and tenant/owner areas are covered by the individual owners.*
- *Owners make their own decisions on upgrades. We have little common area except lobby.*
- *Needs to benefit the entire community.*
- *The tenants are owners, not renters. They buy their own stuff.*
- *No common area needs except lights*
- *The units are individually owned so in general, unless high risk items that can represent a damage to common areas, we only provide recommendations for fixtures inside the units; the associations is responsible for making all decisions about common areas improvements*
- *Board makes decisions on common areas. Board secures tenant approval on each tenant area before upgrading it*
- *Our board decides on common area improvements. Unit owners can decide on their own.*
- *Board is not involved in tenants' decisions regarding purchase of equipment for their units (washers, dryers, appliances, etc.).*
- *It is easier to justify upgrades to common area equipment, because the organization directly benefits from the utility savings.*
- *Common area costs are decided on by the Board of Directors. Individual Owners of units decide on their own for their own units.*
- *We prefer energy efficiency in common areas since they operate almost continuously.*

Overall Program Experience

01. How did you first hear about the program in general?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Other	4	1	3
	6%	3%	8%
PSE'S Website	14	6	8
	20%	19%	21%
Word of Mouth	13	6	7
	18%	19%	18%
A Colleague Recommended It	1	0	1
	1%		3%
My Contractor/A Contractor I've Used Before Recommended It	7	1	6
	10%	3%	15% (s)
A Contractor Contacted Me	4	2	2
	6%	6%	5%
PSE Emailed Me	13	9	4
	18%	28% (f)	10%
Energy Fair	2	1	1
	3%	3%	3%
Tv or Print Advertisement	1	0	1
	1%		3%
Social Media	0	0	0
Trade Show or Industry Event (e.g., Realtor's Meeting, HOA Group etc.)	2	1	1
	3%	3%	3%
Participation in a Different PSE Program	3	1	2
	4%	3%	5%
Don't Know	7	4	3
	10%	13%	8%

Open-End for Customer who marked "Other" (Verbatim):

- Called PSE
- PSE People Came By
- PSE Employees Is an Owner
- City of Seattle

02. In the future, if the program wanted to send you information about rebates and other program services, what would be your preferred way of receiving this information?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Information Included with My Utility Bill	13 18%	8 25%	5 13%
In the Mail, Separate from My Bill	8 11%	1 3%	7 18% (S)
In an Email, Separate from My Bill	41 58%	19 59%	22 56%
On PSE'S Website	5 7%	3 9%	2 5%
Prefer Not to Be Sent This Information	1 1%	0	1 3%
Don't Know	3 4%	1 3%	2 5%

03. Please select the reason that best explains your organization's initial decision to enroll in the program.

Response	Total (T)	Stalled (S)	Full (F)
Total	70	32	38
Other	2 3%	0	2 5%
Reducing Utility Bills	33 47%	17 53%	16 42%
Increasing Tenant Comfort	3 4%	1 3%	2 5%
Increasing Tenant Satisfaction	10 14%	6 19%	4 11%
Environmental Motivations to Make the Property More Green	7 10%	4 13%	3 8%
Getting the Free Audit and Direct-Install Measures	6 9%	3 9%	3 8%
Rebate Offering for Equipment Upgrades	6 9%	1 3%	5 13%
Don't Know	3 4%	0	3 8%

Open-End for Customers who marked "Other" (Verbatim):

- All of The Above
- Getting Free Refrigerators, Light Bulbs and Insulation

04. What benefits have you noticed since your property’s participation in the program? Please select all that apply. [MULTIPLE RESPONSE UNLESS 04=99,98]

Response	Count and % of Total Answering		
	Total (T)	Stalled (S)	Full (F)
Total Answering*	70	31	39
Reduced Utility Bills	39	16	23
	56%	52%	59%
Increased Tenant Comfort	24	6	18
	34%	19%	46% (S)
Increased Tenant Satisfaction	29	10	19
	41%	32%	49%
Reduced Tenant Turnover	2	0	2
	3%		5%
More Attractive Property for New Tenants	12	4	8
	17%	13%	21%
Decreased Vacancy Rates (i.e., Fewer Unoccupied Units)	0	0	0
Reduced Maintenance Costs in Terms of Expenses	21	5	16
	30%	16%	41% (S)
Reduced Maintenance Costs in Terms of Labor Hours	13	5	8
	19%	16%	21%
Other (Still Trying to Determine If It Has Helped Financially)	1	1	0
	1%	3%	
No benefits noticed	7	6	1
	10%	19% (F)	3%
Don't Know	8	3	5
	11%	10%	13%

*Note: One respondent excluded for non-categorical open end that read “These Are Owner-Occupied Condos for Age 55 And Above.”

Audit Experience

A1. You may remember a person coming to inspect the building for potential energy efficiency upgrades, also known as an energy audit. Do you recall this audit?

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
Yes	55	27	28
	77%	84%	72%
No	6	1	5
	8%	3%	13%
Don't Know/Can't Recall	10	4	6
	14%	13%	15%

[ASK IF A1=01, ELSE SKIP TO NEXT SECTION]

A2. Did you learn of any energy efficiency opportunities that you or your organization was unaware of prior to the audit?

Response	Total (T)	Stalled (S)	Full (F)
Total Answering	55	27	28
Yes	30	14	16
	55%	52%	57%
No	13	8	5
	24%	30%	18%
Don't Know/Can't Recall	12	5	7
	22%	19%	25%

A3. Please indicate your level of satisfaction with the audit experience overall.

Response	Total (T)	Stalled (S)	Full (F)
Total Answering	55	27	28
1 - Not at All Satisfied	0	0	0
2	1	1	0
	2%	4%	
3	9	5	4
	16%	19%	14%
4	11	3	8
	20%	11%	29% (s)
5 - Very Satisfied	33	18	15
	60%	67%	54%
N/A	1	0	1
	2%		4%
Average Rating	4.41	4.41	4.41

[ASK IF A3 < 3]

A4. Why were you less than satisfied with the audit experience? **[MULTIPLE RESPONSE]**

Response	Total (T)	Stalled (S)	Full (F)
Total Answering	2	1	1
Inspector Showed Up Late	1	1	0
	50%	100%	
Audit Took Too Long	1	0	1
	50%		100%
Audit Didn't Teach Me Anything New	1	1	0
	50%	100%	
Other (Not Organized)	1	1	0
	50%	100%	

A5. What suggestions do you have, if any, for improving the audit stage of the program? [OPEN END; 96="No additional feedback"]

Customer Feedback from A5 (Verbatims):

- *less power outage*
- *Everything was great TY*
- *I have none. It was well organized.*
- *Great program! I like my new energy efficient light bulbs and love my new Nest Thermostat!*
- *Question if it is necessary although it did help them to determine the # of bulbs needed*
- *Thank you for your excellent service and follow up*
- *thought it was interesting*
- *being more organized*
- *Face to face interaction with clients/residents works better on our properties rather than just holding resident meetings.*
- *PLEASE KEEP IT GOING EVERY YEAR! We love the program and hope to use it on future rehab projects.*
- *It was an excellent service. I coordinated it for our 42-unit condo project. It would be nice if condo owners could have their own unit done without needing to enlist a majority of other owners; it was a lot of work – and worth it. Thank you.*
- *I do not remember receiving an "Audit Report".*
- *The audit stage of this program went very well, and I have no suggestions to change it.*

A6. How likely would you have been to conduct an energy audit of the property at <SHORT_ADDRESS> without the multifamily retrofit program?

Response	Total (T)	Stalled (S)	Full (F)
Total	55	27	28
1 - Not at All Likely	19	10	9
	35%	37%	32%
2	16	9	7
	29%	33%	25%
3	6	4	2
	11%	15%	7%
4	3	0	3
	5%		11%
5 - Very Likely	7	3	4
	13%	11%	14%
Don't Know	4	1	3
	7%	4%	11%
Average Rating	2.27	2.12	2.44

Direct Install

[ASK IF (participant_type=B OR D); ELSE SKIP TO NEXT SECTION]

DI1. [IF ONSITE=0: Our records indicate] [IF ONSITE=1: Onsite visits confirmed] that you received some free products such as light bulbs or showerheads. These products were either left behind to install or directly installed for you. Do you recall receiving these measures?

Response	Total (T)	Stalled (S)	Full (F)
Total	39	24	15
Yes	36	23	13
	92%	96%	87%
No	0	0	0
Don't Know/Can't Recall	3	1	2
	8%	4%	13%

[ASK IF DI1=01 OR ONSITE=1; ELSE SKIP TO NEXT SECTION]

DI2. Please indicate your level of satisfaction with the products.

Response	Total (T)	Stalled (S)	Full (F)
Total Answering	36	23	13
1 - Not at All Satisfied	0	0	0
2	1	1	0
	3%	4%	
3	6	3	3
	17%	13%	23%
4	9	6	3
	25%	26%	23%
5 - Very Satisfied	20	13	7
	56%	57%	54%
Average Rating	4.33	4.35	4.31

[ASK IF DI2 < 3]

DI3. Why were you less than satisfied with the free products you received through the program? Please select up to four responses if applicable.

Response	Total (T)
Total	2
Other (Tenants Not Happy with The Lumens. Upgrade Didn't Cover All the Light Bulbs in Each Home)	1
	50%
Installer was Late	1
	50%

DI4. What suggestions do you have, if any, to improve the direct install products or direct installation process? [OPEN END, 96="No additional feedback"]

Customer Feedback from DI4 (Verbatims):

- *different light bulbs. Too dim for the elderly residents*
- *water reducing pulls in shower are hard for some of our residents to understand how to use.*
- *This was well received by all home owners!*
- *Auditor/Installer was unable to retrofit several showerheads with water saving units*
- *Make sure everyone knows beforehand that only certain light bulbs will be replaced.*
- *Notification ahead of time that faucet aerators and showerheads won't work on all units. Notification that these may be left for user install instead of direct install.*
- *The whole process was really wonderful. Thank you!*
- *Make the program better known to possible participants, and easier for owners of condominiums.*
- *We had approximately 50 owners participate, and all are very happy with the products they received.*

DI5. How likely were you to install these energy-saving products had you NOT participated in the Multifamily Retrofit program?

Response	Total (T)	Stalled (S)	Full (F)
Total	36	23	13
1 - Not at All Likely	9 25%	7 30%	2 15%
2	11 31%	5 22%	6 46%
3	5 14%	3 13%	2 15%
4	3 8%	0	3 23%
5 - Very Likely	5 14%	5 22%	0
Don't Know	3 8%	3 13%	0
Average Rating	2.52	2.55	2.46

Rebated Measures

[ASK IF participant_type=C OR D; ELSE SKIP TO NEXT SECTION]

RM1. [READ IF ONSITE=0: Our records indicate] [READ IF ONISITE=1: Onsite visits confirmed] that this property received financial incentives for energy efficient measures. Using the chart below, please [IF ONSITE=0: indicate] [IF ONSITE=1: reconfirm] whether or not upgrades and/or measures were installed at your property within each of the following categories.

Rebated Measure	Count and Percentage of Total Answering			
	Total Answering	Installed	Did not have installed	Don't Know
a. [ASK IF envelope_ind=1] Upgrades to building envelope (e.g., air sealing, insulation, windows or doors, or ventilation)	25	17	2	6
		68%	8%	24%
b. [ASK IF appliance_ind=1] Energy Efficient Appliances (e.g., clothes washer, dryer, refrigerator, etc.)	1	1	0	0
		100%		
c. [ASK IF ca_lght_ind =1] Lighting for common areas	10	10	0	0
		100%		
d. [ASK IF tstat_ind =1] Thermostats	2	2	0	0
		100%		
e. [ASK IF wt_ht_ind=1] Energy efficient water heating upgrades (e.g., boiler, heat pump water heater)	1	1	0	0
		100%		
f. [ASK IF spc_ht_ind=1] Energy efficient space heating upgrades (e.g., DHP, combined space and water heater, ventilation fan, fireplace, furnace etc.)	7	5	0	2
		71%		29%

[ASK FOR EACH RM1a-f=01; ELSE SKIP TO NEXT SECTION]

RM2. Who performed the installation of the energy efficiency equipment for which you received financial incentives?

Rebated Measure	Total Answering	Count and Percentage of Total Answering by Response				
		Property Staff	Contractor from PSE's Contractor Alliance Network	3 rd Party Contractor	Equipment Vendor	Don't Know
a. [ASK IF envelope_ind=1] Upgrades to building envelope (e.g., air sealing, insulation, windows or doors, or ventilation)	17	1	11	4	0	1
		6%	65%	24%		6%
b. [ASK IF appliance_ind=1] Energy Efficient Appliances (e.g., clothes washer, dryer, refrigerator, etc.)	1	1	0	0	0	0
		100%				
c. [ASK IF ca_lght_ind =1] Lighting for common areas	10	1	4	3	1	1
		10%	40%	30%	10%	10%
d. [ASK IF tstat_ind =1] Thermostats	2	0	1	1	0	0
			50%	50%		
e. [ASK IF wt_ht_ind=1] Energy efficient water heating upgrades (e.g.,	1	0	0	1	0	0

boiler, heat pump water heater)				100%		
f. [ASK IF spc_ht_ind=1] Energy efficient space heating upgrades (e.g., DHP, combined space and water heater, ventilation fan, fireplace, furnace etc.)	5	0	2	3	0	0
			40%	60%		

[ASK IF ANY RM2a-f=02]

RM3. How did you and/or your organization find the contractor from PSE’s contractor alliance network (CAN)?

Response	Count
Total Answering	17
An Email From PSE	5
	29.4%
The Contractor Directly Reached Out to Me	4
	23.5%
PSE Staff Put Me in Touch with the Contractor	3
	17.6%
PSE'S Website	1
	5.9%
Don't Know	1
	5.9%
Previously worked with a contractor	3
	17.6%

RM4. Please indicate your level of satisfaction with each of the following. [ROTATE]

Response	Average Score	Count (Total Answering = 32)					
		1	2	3	4	5	Not Applicable
		Not at All Satisfied				Very Satisfied	
a. (ab) The rebate application process and forms	4.20	0	3	2	11	14	2
b. The rebate amounts offered	4.22	0	3	4	8	17	0
c. The products eligible for rebates	4.13	0	1	8	8	14	1
d. Assistance in finding contractors to install rebate-eligible measures	4.09	0	3	4	3	12	10
e. The installation quality	4.42	0	0	5	8	18	1
f. The product quality	4.47	0	0	4	9	19	0
g. The energy savings you experienced after installation	4.20	0	1	7	7	15	2

[ASK IF any RM4a-h < 3]

RM5. Why were you less than satisfied with the rebate portion of the program? Please select up to three responses if applicable.

Response	Count
Total	6
The Rebate Application was Complicated	1 16.7%
The Rebates were Not Large Enough	3 50.0%
It Took a Long Time to Receive a Rebate	1 16.7%
Other (Not All Of The Expected Changes Qualified For Rebate- Discovered Well Into Process/ Still Evaluating the Energy Cost Savings)	2 33.3%

RM6. What suggestions do you have, if any, to improve the program? [OPEN END]

Customer Feedback from RM6 (Verbatims):

- Follow up on rebate received.
- I found out about the program through a contractor that we ended up not using and the contractor we did use was unaware of the program. I would suggest keeping all local relevant contractors up to date on PSE rebate offerings. The online rebate form is clunky and the rebate options were embedded in the form in a way that was not at all obvious. Developing a more user friendly online form would improve customer satisfaction.
- I would have chosen to install updated and more efficient common area lighting if the ROI would have been closer to 3 years rather than 7 or so.
- Keep up the good work your company provides to us who pay the bills.
- Larger incentives on new washer and dryers along with hot water tanks. The incentives are too small and there is no motivation for a landlord to make the switch without a larger incentive.
- Make you survey a little shorter
- More information on water and power improvements
- No recommendations. PSE does a very good job with their rebate programs.
- Pay for a higher percentage of the windows.
- Refrigerator recycling and pickup for \$25 was too complicated for multifamily units. It is just easier to forgo \$25 and have H4H or likewise pickup.
- speed it up
- Thank you for the support. PSE support made it possible
- We have smaller properties that really don't fit the criteria of multifamily or single-family home and sometimes its hard to find the right fit.
- When a group of individuals showed up to install Embertec Emberplug, they didn't install. They left it for the maintenance director to install.

RM7. How likely were you to install these measures WITHOUT the rebates offered through the program?

Average Score	Count (Total Answering = 32)					
	1 Not at All Likely	2	3	4	5 Very Likely	Don't Know
2.42	10	7	8	3	3	1

RM10. How important were the following factors in your decision to purchase these energy efficient upgrades through the PSE program? [ROTATE]

Response	Average Rating	Count (Total Answering = 32)						
		1	2	3	4	5	Not Applicable	Don't Know
		Not at All Important				Very Important		
a. Rebate amounts offered through the program	4.35	0	1	4	9	17	0	1
b. The program's help in identifying which products to install	3.81	3	0	6	8	10	3	2
c. The education you received from the audit	3.74	2	2	5	10	8	4	1
d. The amount of utility bill savings you receive from installing EE equipment	4.00	1	1	6	8	11	1	4
e. The program's help in finding contractors to install the EE equipment	3.48	4	3	5	3	10	5	2

RM11. What barriers, if any, did you have to overcome to participate in the rebated-measure portion of the program? By barriers, we mean anything that might have prevented you from installing and/or receiving a rebated measure. [OPEN END; 96= "No barriers"]

Open-Ends (Verbatim):

- Time to research and make application
- I was not aware that you helped locate someone to do the installation.
- Website says no rebate for multifamily property, but I called PSE and they said there was a rebate available.
- Process and reduced rebate amount between receiving bids and ordering items
- The equipment was expensive, the rebate made it easier

Rebated Equipment: Interest and Barriers

[ASK IF participant_type = A OR B; ELSE SKIP TO NEXT SECTION]

RE1. Do you recall the program recommending any energy efficient upgrades?

Response	Count
Total Answering	32
Yes	18
	56%
No	2
	6.3%
Don't Know/Can't Recall	12
	38%

RE2. [IF RE1=02: Just to confirm that no upgrades were recommended to you,] Using the chart below, please indicate which energy efficient upgrades were recommended to you.

Recommended EE Improvement Measures	Count (Total Answering = 32)		
	Eligible for upgrade / Recommended to me	Not eligible for upgrade / Not recommended to me	Don't Know
a. Ways to improve the building envelope on the property through upgrades such as air sealing, insulation, windows or doors, or ventilation	6	14	12
b. Appliances such as clothes washers, clothes dryers, and/or refrigerators	7	11	14
c. Lighting for common areas	16	7	9
d. Thermostat options	7	13	12
e. Energy efficient water heating options	6	13	13
f. Energy efficient space heating options	3	16	13
g. Refrigerator recycling	5	11	16

[ASK IF ANY RE2a-h=01]

RE3. Have you installed or made any of these recommended upgrades? Please do not include items you may have received for free through the program, such as LEDs and showerheads.

Response	Count
Total Answering	19
Yes	9 47.4%
No	10 52.6%
Don't Know	0

[ASK IF RE3=02,98]

RE4. Do you plan to install or make any of the recommended upgrades within the next year?

Response	Count
Total Answering	10
Yes	3 30.0%
No	4 40.0%
Don't Know	3 30.0%

[ASK FOR EACH RE2a-h=01 IF RE3=01 OR IF RE4=01,98: ELSE SKIP TO R8]

RE5. Using the chart below, please indicate which of the recommended upgrades you installed or plan to install.

Recommended EE Improvement Measures	Count				
	Total Answering	Installed	Plan to Install	Not Installed <u>AND</u> Do not plan to	Not Installed and plan to replace on failure
a. Ways to improve the building envelope on the property through upgrades such as air sealing, insulation, windows or doors, or ventilation	6	1	2	1	2
b. Appliances such as clothes washers, clothes dryers, and/or refrigerators	6	2	1	1	2
c. Lighting for common areas	13	8	3	0	2
d. Thermostat options	7	1	2	1	3
e. Energy efficient water heating options	5	2	1	1	1
f. Energy efficient space heating options	2	0	0	1	1
g. Refrigerator recycling	4	1	3	0	0

[ASK IF ANY RE5a-h=01]

RE6. Did you seek out a rebate from PSE for all of the upgrades you installed?

Response	Count
Total	9
Yes for All Upgrades	4 44%
Yes for Some Upgrades	2 22%
No	2 22%
Don't Know	1 11.1%

[ASK IF ANY RE5a-h=02]

RE7. Do you plan to seek a rebate from PSE for the upgrades you plan to install?

Response	Count
Total	5
Yes for All Upgrades	4 80%
Yes for Some Upgrades	1 20%
No	0
Don't Know	0

[ASK IF RE6=02,03] [ASK IF RE7=02, 03]

RE6a and RE7a (combined). Why didn't you seek a rebate for all of the upgrades you installed?

Response	Count
Total	5
Other	3
	60%
I Didn't Know Whether a Rebate was Available	1
	20%
Don't Know	1
	20%

Open-End for Customers who marked “Other” (Verbatim):

- *Haven't Done an Upgrade That Qualified Yet.*
- *Rebate for Lighting Was Through Seattle City Light*
- *We Didn't Upgrade All Windows and My Understanding Is You Could Only Qualify for The Rebate If You Upgraded The Entire Property.*

[ASK IF ANY RE5a-h=03 OR IF [RE3=02 AND RE4=02], ELSE SKIP TO NEXT SECTION]

RE8. Why are there no plans to install some of the recommended upgrades?

Response	Count
Total	7
Financial Limitations	3
	43%
Tenants Pay Their Own Utility Bills	1
	14%
Lack of Maintenance Staff to Install Measures	1
	14%
Only Replacing on An As-Needed Basis	1
	14%
Inconvenience/Disruption to Tenants	1
	14%

RE9. What, if any, additional information would help you implement these measures? Please select all that apply. [MULTIPLE RESPONSE UNLESS = 98, 99]

Response	Count
Total	7
Detailed Bid Information Provided During a Follow-Up Visit	1
	14%
Additional Contact with the Audit Inspector	1
	14%
Additional Rebate-Eligible Measure Information	4
	57%
Other	1
	14%
No Additional Information Would Help Me Implement These Measures	3
	43%

Open-End for Customer who marked “Other” (Verbatim):

- *Not Enough Of A Rebate Vs Payback For Owner*

RE10. What, if any, kind of financial support would you need to implement these recommended measures?
Please select all that apply. [MULTIPLE RESPONSE UNLESS = 98, 99]

Response	Count
Total Answering	7
Lower Measure Cost Up-Front (i.e. Instant Discount)	4 57%
Increased Incentive/Rebate	4 57%
No Additional Financial Support Would Help Me Implement These Measures	1 14%

Overall Program Satisfaction

05a. Please indicate your level of satisfaction with the program overall.

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
1 - Not at All Satisfied	1 1%	1 3%	0
2	1 1%	1 3%	0
3	17 24%	10 31%	7 18%
4	17 24%	5 16%	12 31%
5 - Very Satisfied	35 49%	15 47%	20 51%
Average Rating	4.18	4.00	4.33

05b. Please indicate how you think the tenants would rate the program.

Response	Total (T)	Stalled (S)	Full (F)
Total	71	32	39
1 - Not at All Satisfied	2 3%	2 6%	0
2	2 3%	2 6%	0
3	20 28%	11 34%	9 23%
4	19 27%	7 22%	12 31%
5 - Very Satisfied	28 39%	10 31%	18 46%
Average Rating	3.97	3.66	4.23 (S)

[ASK IF ANY 05a-b < 3]

06. Why are you and/or your tenants less than satisfied with the program?

Customer Feedback from O6 (Verbatims):

- *I Guess Everyone Likes Wasting Energy*

Closing

C1. Is there anything else you would like to add to help PSE improve the program? [OPEN END, 96=Nothing additional to add]

Comment Type	Count
Total Answering	71
Positive Feedback, No Suggestions for Improvement	7
Need Better Incentives for Expensive Upgrades	3
Feedback related to wanting Additional Information/Clarification/Follow-Up from Program	4
Survey-Related Feedback	2
Nothing to Add	55

Customer Feedback from C1 (Verbatims):

- *This questionnaire does not in some ways fit our complex, condominiums for over-age-55 individually owned and occupied. There is no overall "management" except by residents who are on the Board of Directors. I did the best I could.*
- *Keep the programs coming. Thank you.*
- *Everyone was very helpful. the contact person who sets up the schedule was great.*
- *It's been a wonderful program. Cannot say enough how appreciative we are and hope to carry on with this program in future. We are also upgrading our toilets at the property using rebates from City of Kent. So...trying to do our part. Your team has been a pleasure to work with as well.*
- *clarify info on website for multifamily rebates*
- *Have it geared to building owners. I do not pay the electric heating bills of each unit. I cannot raise the rents enough to warrant the very high costs of window replacements. Longevity of windows offered to me had too many warranty problems.*
- *Great job done by the PSE workers who came into about 50 units and replaced bulbs, shower heads, wrapped pipes and replaced aerators. All took off their shoes when entering my unit and all were very pleasant to work with.*
- *Thank you for these kinds of programs*
- *The incentives are a big part of making this program useful. We did not insulate floors because of the high cost and reduced incentive in this area.*
- *We were told about the washer/dryer replacement program, but I do not recall hearing about the hot water heater or fridge replacement program.*
- *we were to have the thermostats inspected but you cancelled on several occasions and we never heard anything back*
- *Please offer a list of possible installers, and contractors who can do the critical measurements.*
- *I hope 1631 passes and you add to the amount you pay for the windows so that owners pay only 1/3, instead of 2/3.*
- *Thank you for all you do to assist our mutual clients with energy efficiency*
- *this is too long*
- *This program was introduced to community before our Management company took over.*

Appendix B. Evaluated Savings Detailed Tables

Table 33 summarizes the evaluated and reported savings for each measure included in the 60 sampled properties. Common area lighting accounts for nearly 67% of the overall sampled reported savings, thus having a significant impact on the overall program realization rates.

Table 33. Reported and Evaluated Sampled Savings by Measure

Measure	Reported kWh Savings	Reported Therm Savings	Evaluated kWh Savings	Evaluated Therm Savings
Common Area Lighting	3,312,756	-	3,336,002	-
Windows	641,894	3,888	641,894	4,431
Ductless Heat Pump	242,778	-	242,778	-
Attic Insulation	203,276	220	227,728	301
Powerstrip	197,084	-	37,762	-
Air Sealing	139,135	-	139,135	-
LED (A-Lamp)	64,329	-	54,785	-
Showerheads w/ TRV Adapter	50,250	213	33,081	268
LED (Globe)	40,115	-	36,327	-
TRV Adapter Only	39,273	235	31,488	333
Kitchen Aerator	2,466	44	1,043	44
LED (Candelabra)	1,936	-	1,374	-
Bathroom Aerator	1,001	41	2,309	46
LED (Reflector)	860	-	777	-
Boiler	-	9,737	-	9,661
Integrated Space & Water Heating	-	259	-	259
Total	4,937,154	14,637	4,786,483	15,344

Table 34 shows the reported and evaluated savings for each measure installed at each sample property. The site visit persistence rates are unique by property and were incorporated in the evaluated savings and accounted for in the overall extrapolation to the population.

Table 34. Reported and Evaluated Sampled Savings by Measure and Property

Measure	ODCID ¹	Persistence Rate	Reported kWh Savings	Reported Therm Savings	Evaluated kWh Savings	Evaluated Therm Savings
TRV Adapter Only	8	62%	1,961	-	1,207	-
Windows	8	100%	106,432	-	106,432	-
Ductless Heat Pump	10	100%	95,724	-	95,724	-
Common Area Lighting	14	95%	83,845	-	83,845	-

Measure	ODCID ¹	Persistence Rate	Reported kWh Savings	Reported Therm Savings	Evaluated kWh Savings	Evaluated Therm Savings
Common Area Lighting	20	100%	79,543	-	79,769	-
Common Area Lighting	21	97%	129,063	-	129,966	-
LED (A-Lamp)	33	86%	13,133	-	11,297	-
LED (Candelabra)	33	60%	191	-	115	-
LED (Globe)	33	101%	20,772	-	21,032	-
Powerstrip	33	26%	63,180	-	16,380	-
TRV Adapter Only	33	86%	-	222	-	315
Common Area Lighting	44	100%	19,580	-	20,588	-
Common Area Lighting	45	100%	29,198	-	29,238	-
Bathroom Aerator	58	300%	308	-	1,026	-
Kitchen Aerator	58	25%	1,166	-	162	-
LED (A-Lamp)	58	96%	6,575	-	3,166	-
LED (Candelabra)	58	50%	64	-	32	-
LED (Globe)	58	100%	6,028	-	3,014	-
Powerstrip	58	21%	30,600	-	3,188	-
Showerheads w/ TRV Adapter	58	75%	27,470	-	10,301	-
TRV Adapter Only	58	100%	159	-	159	-
Attic Insulation	66	100%	33,974	-	38,796	-
Common Area Lighting	84	100%	124,808	-	124,808	-
Common Area Lighting	85	100%	56,335	-	56,722	-
Boiler	104	100%	-	1,108	-	1,108
Boiler	106	100%	-	1,220	-	1,220
Air Sealing	120	100%	139,135	-	139,135	-
Common Area Lighting	120	100%	12,852	-	12,852	-
Bathroom Aerator	129	400%	154	-	684	-
Kitchen Aerator	129	25%	269	-	75	-
LED (A-Lamp)	129	71%	5,947	-	4,249	-
LED (Candelabra)	129	100%	600	-	600	-
LED (Globe)	129	84%	4,033	-	3,382	-
LED (Reflector)	129	90%	828	-	746	-
Powerstrip	129	7%	35,640	-	2,376	-
TRV Adapter Only	129	93%	7,261	-	6,742	-
Common Area Lighting	131	100%	130,965	-	130,995	-
Common Area Lighting	136	100%	40,194	-	40,194	-
Attic Insulation	156	100%	133,192	-	147,699	-
Attic Insulation	163	100%	14,968	-	17,092	-
Bathroom Aerator	163	100%	539	-	599	-
Kitchen Aerator	163	67%	404	-	299	-
LED (A-Lamp)	163	88%	9,136	-	8,080	-

Measure	ODCID ¹	Persistence Rate	Reported kWh Savings	Reported Therm Savings	Evaluated kWh Savings	Evaluated Therm Savings
LED (Candelabra)	163	0%	36	-	-	-
LED (Globe)	163	100%	71	-	71	-
LED (Reflector)	163	100%	32	-	32	-
Powerstrip	163	38%	15,336	-	5,898	-
TRV Adapter Only	163	75%	2,226	-	1,670	-
Common Area Lighting	165	100%	143,117	-	143,116	-
TRV Adapter Only	193	67%	8,268	-	2,756	-
Bathroom Aerator	206	100%	-	34	-	38
Kitchen Aerator	206	100%	-	42	-	42
LED (A-Lamp)	206	116%	3,403	-	3,944	-
Powerstrip	206	0%	8,512	-	-	-
Showerheads w/ TRV Adapter	206	89%	-	170	-	241
TRV Adapter Only	206	83%	-	13	-	18
Common Area Lighting	210	100%	31,173	-	31,219	-
Common Area Lighting	214	100%	149,510	-	150,393	-
Kitchen Aerator	225	73%	628	-	507	-
LED (A-Lamp)	225	91%	16,883	-	15,331	-
LED (Candelabra)	225	67%	927	-	618	-
LED (Globe)	225	100%	42	-	42	-
Powerstrip	225	25%	32,942	-	8,236	-
Showerheads w/ TRV Adapter	225	100%	22,780	-	22,780	-
TRV Adapter Only	225	100%	12,296	-	12,296	-
Common Area Lighting	229	98%	248,018	-	247,340	-
Boiler	247	100%	-	780	-	780
Windows	248	100%	691	-	691	-
LED (A-Lamp)	259	96%	5,749	-	5,500	-
LED (Candelabra)	259	0%	91	-	-	-
LED (Globe)	259	96%	9,169	-	8,786	-
Powerstrip	259	31%	5,474	-	1,684	-
TRV Adapter Only	259	94%	7,102	-	6,658	-
Common Area Lighting	265	100%	552,776	-	552,792	-
Common Area Lighting	267	96%	85,526	-	70,603	-
Boiler	270	100%	-	956	-	887
Common Area Lighting	273	93%	233,545	-	233,545	-
Windows	278	100%	-	1,776	-	2,024
Attic Insulation	279	100%	21,141	-	24,141	-
Windows	284	100%	129,984	-	129,984	-
Windows	285	100%	343,309	-	343,309	-
Common Area Lighting	300	100%	66,738	-	66,640	-

Measure	ODCID ¹	Persistence Rate	Reported kWh Savings	Reported Therm Savings	Evaluated kWh Savings	Evaluated Therm Savings
Boiler	306	100%	-	733	-	733
Common Area Lighting	340	97%	58,573	-	58,573	-
Common Area Lighting	371	100%	133,817	-	133,831	-
Common Area Lighting	376	100%	69,697	-	69,697	-
Boiler	384	100%	-	2,371	-	2,365
Integrated Space & Water Heating	391	100%	-	259	-	259
Common Area Lighting	392	100%	7,232	-	7,232	-
Common Area Lighting	394	100%	37,507	-	37,456	-
LED (A-Lamp)	394	92%	3,502	-	3,219	-
LED (Candelabra)	394	33%	27	-	9	-
Powerstrip	394	0%	5,400	-	-	-
Boiler	396	100%	-	1,871	-	1,871
Common Area Lighting	397	100%	83,475	-	83,483	-
Ductless Heat Pump	404	100%	147,054	-	147,054	-
Boiler	409	100%	-	698	-	698
Showerheads w/ TRV Adapter	410	100%	-	17	-	27
Windows	446	100%	-	2,112	-	2,407
Common Area Lighting	464	100%	80,045	-	79,528	-
Attic Insulation	475	100%	-	220	-	301
Common Area Lighting	495	100%	10,066	-	10,231	-
Common Area Lighting	496	100%	291,360	-	308,012	-
Bathroom Aerator	505	100%	-	7	-	8
Kitchen Aerator	505	100%	-	2	-	2
Showerheads w/ TRV Adapter	505	0%	-	26	-	-
Windows	509	100%	61,478	-	61,478	-
Common Area Lighting	516	100%	324,198	-	343,332	-
Total			4,937,154	14,637	4,786,483	15,344

¹ The ODCID represents each unique property within the evaluation sample.

Appendix C. Simple Random Sample (SRS) Ratio-Model Approach

The evaluation team implemented the following sampling approach to calculate ratios (realization rates) for sampled properties who receive both electric and gas (combo) service from PSE.

Equation 1. Simple Random Sample Ratio

$$r = \bar{y} \div \bar{x}$$

where:

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

\bar{y} = sample evaluated mean

\bar{x} = sample reported mean

The standard error of the ratio estimate is given by:

Equation 2. SRS Standard Error of Ratio Estimate

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

where:

N = population of properties

n = sample of properties

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

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

s_x = reported standard deviation of sample

s_y = evaluated standard deviation of sample

$$\hat{\rho}_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{(n-1)s_x s_y}$$

Appendix D. Stratified Sample Ratio-Model Approach

The evaluation team implemented the following sampling approach to calculate ratios (realization rates) for sampled properties who receive either electric or gas service from PSE.

The components of the program that warranted stratified sampling followed the combined method of calculating the realization rate and its standard error. This method was appropriate because there were too few participants in some strata to support separate ratio estimates. The method is as follows:

Equation 3. Stratified Sample Ratio

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

where:

r_{strc} = stratified-combined ratio of evaluated to reported sample estimates, or realization rate

\bar{y}_{str} = stratified sample evaluated mean

\bar{x}_{str} = stratified sample reported mean

The variance of the ratio is given by:

Equation 4. Stratified Sample Variance of the Ratio

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

where:

N_h = number of properties in population of stratum h

X_h = reported population mean in stratum h

n_h = number of properties in sample of stratum h

\bar{x}_h = estimated reported sample mean in stratum h

and:

$$\sigma_{hz}^2 = \hat{\sigma}_{hy}^2 + R^2 \hat{\sigma}_{hx}^2 - 2R \hat{\rho}_{hxy} \sigma_{hy} \sigma_{hx}$$

where:

R = ratio or realization rate

$\hat{\sigma}_{hy}^2$ = estimated variance of the evaluated savings in stratum h

$\hat{\sigma}_{hx}^2$ = estimated variance of the reported savings in stratum h

$\hat{\rho}_{hxy}$ = estimated correlation between x and y in stratum h

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

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