MULTIFAMLY RETROFIT

Final Report
2022-2023 Impact and Process Evaluation

Puget Sound Energy

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1 EXECUTIVE SUMMARY

This report summarizes the results of the impact and process evaluations of Puget Sound Energy's (PSE) Multifamily Retrofit program for the 2021 and 2022 program years.

1.1 Program Description

PSE's Multifamily Retrofit program is a midstream and downstream program that offers comprehensive retrofit and strategic energy management opportunities for residential building envelope, common areas, and in-unit dwellings. Incentives are available for efficiency measures including weatherization, heating, ventilation, and air-conditioning (HVAC), controls, behavioral modifications, lighting, and appliances. The program aims to increase the installation of these measures in existing multifamily buildings by working with property owners, managers, trade ally contractors, tenants, and multifamily campuses. The 2022 program emphasized the recruitment of low income and vulnerable demographics. Direct install (DI) measures, audits, and marketing and outreach activities are implemented by a third-party contractor (CLEAResult), while common area and building envelope measures are implemented by PSE's network of contractors.

1.2 Research Objectives

The primary research objective of this impact evaluation was to estimate the energy savings attributable to the program. To evaluate energy savings, DNV gathered key information in telephone interviews with property managers, which included remote verification to confirm the installation of measures incentivized through the program. These interviews helped to characterize site-specific building usage, occupancy patterns, and occupant behavior, which are key components for evaluating energy savings of the program measures. The primary research objectives of the process evaluation were to assess program awareness, participant satisfaction, and perceived barriers to program participation.

1.3 Impact Evaluation Results

The impact evaluation produced overall energy savings estimates for the program and savings estimates for measure categories that received incentives through the program. We should note that nearly 90% of the program's reported energy savings were electric savings and about 11% were gas savings. Thus, our approach to the impact evaluation focused primarily on measures that achieved electric savings. We summarize the results of the impact evaluation below.

- **Total Evaluated Savings:** The program achieved total evaluated savings of 38,914 MMBtu, which included 9,853,491 kWh of electric savings, and 29,703 therms of gas savings in the 2021 and 2022 program years.
- **Overall Realization Rate:** The program's overall realization rate was 88%. This metric is the ratio of the actual (evaluated) savings to the claimed (reported) savings.

The evaluation revealed variance between claimed and evaluated savings for some measure categories:

- **Windows:** A significant difference was observed between reported savings (20,207 MMBtu) and evaluated savings (9,089 MMBtu), resulting in a realization rate of 45% for this measure. The lower realization rate for windows is mostly attributable to an overestimation of windows savings in the Regional Technical Forum's (RTF) assumptions.
- **Lighting:** Evaluated savings (11,882 MMBtu) considerably exceeded reported savings (8,171 MMBtu) with a realization rate of 145%. The higher than expected savings were largely driven by higher than assumed hours of use in common areas among sampled sites.
- **Thermostats:** The reported savings were passed through and the realization rate for thermostats was 100%. Conducting a billing analysis specifically for the smart thermostat measure in multifamily buildings was not feasible given the gaps in consumption data for specific units, issues with the accuracy of some addresses within the project files, and the significant challenges of identifying a multifamily comparison group in non-participating multifamily

buildings without smart thermostats. Previous evaluations of PSE's smart thermostats in single family homes, including the 2017-2018 and 2021-2022 program year evaluations, showed no statistically significant electric savings associated with smart thermostats. The RTF assumes relatively small per unit electric savings for smart thermostats in multifamily buildings. However, given the lack of evidence that smart thermostats produce any electric savings, even these conservative savings estimates may be too high.

- **Envelope:** The evaluated savings for envelope measures (10,032 MMBtu) significantly surpassed the reported savings (4,715 MMBtu), with a realization rate of 213%. While this may indicate a potential underestimation of energy savings from envelope measures, claimed savings for the measure were only 11% of total claimed savings for the program, and only three sites with envelope measures were analyzed as part of the evaluation.
- **Other Measures:** Due to the diversity of measures in this category and sampling constraints, these measures were assigned a realization rate of 100%. "Other" measures represented only 5% of the program's claimed energy savings. A DNV engineer reviewed the deemed savings assumptions in the RTF for the other measures and found these assumptions to be reasonable.

1.4 Process Evaluation Results

The process evaluation is designed to provide insights into how the Multifamily Retrofit program is performing and to determine the extent to which there are opportunities to increase program savings. This year's evaluation included an interview of PSE Multifamily Retrofit program manager and program implementer staff and a large-scale online survey of program participants to understand their behaviors and attitudes.

Online survey results revealed that many participants found out about the Multifamily Retrofit program through PSE's marketing and communication efforts (collectively 41%), such as from PSE's website (15%), PSE's Energy Advisory (13%), or from a PSE phone call, direct mall, or email (13%). Almost a quarter (24%) found out about the program from their contractor.

Survey respondents were also asked about their satisfaction with various aspects of the program using a 5-point scale, where "5" means "very satisfied" and "1" means "very dissatisfied." All categories yielded high average satisfaction scores, ranging from 4.5 to 4.6. Participants were most satisfied with the program's equipment offerings (4.6), with only a slightly lower average satisfaction associated with their energy and cost savings resulting from their program participation (4.5) and their overall program experience (4.5).

The online survey also revealed that almost half (49%) of building staff stated that utility rebates / incentives were the primary driver for their participation, with 18% citing tenant benefits or appeal to renters. Survey results also suggest that over half (53%) of the respondents would have not installed equipment of the same efficiency without the program rebates.

Evaluators asked respondents what concerns or barriers, if any, they had related to their participation in the Multifamily Retrofit program. Over a third of respondents reported disruptions to tenants (21%) or hesitancy from tenants or other stakeholders (17%) as a barrier to program participation. Other commonly reported concerns or barriers included the time commitment or how long the project took (17%), higher upfront cost or investment (16%), or program and eligibility requirements (12%).

1.5 Key Findings and Recommendations

The key findings and recommendations from the evaluation are summarized below.

1.5.1 Key Findings

Key findings from the Multifamily Retrofit program impact and process evaluation are as follows:

FINDINGS

Overall Realization Rates: The program's overall realization rate was 88% for electric and gas savings combined. Electric savings accounted for nearly 90% of overall program savings. The realization rate for electric savings was 88%, and the realization rate for gas savings was 63%. This rate reflects the program's outcomes in terms of achieving its energy-saving targets, with varying results across different measures.

- **Electric Savings:** The program's evaluated electric savings were 9.9 million kWh, while the reported electric savings were 11.2 million kWh.
- **Gas savings:** The program's evaluated gas savings were more than 29,700 therms compared to reported gas savings of over 46,900 therms.

Lower Realization Rate for Windows: The realization rate for Windows was 45%, indicating a variance between the reported and evaluated savings. The primary contributor to this lower realization rate for windows was an overestimation of windows savings in the RTF's deemed savings assumptions. While PSE correctly applied the RTF savings assumptions for Window measure, these savings assumptions are too high.

Data Limitations for Evaluating Smart Thermostats: The thermostat measure's savings were accepted as reported due to data limitations, including inaccurate building address information for some projects and insufficient granularity for unit-level and common area consumption data, and challenges associated with conducting a billing consumption analysis for evaluating savings for smart thermostats in multifamily buildings. While the per unit electric savings claimed for smart thermostats in multifamily buildings is relatively small, multiple studies have shown small or no electric savings associated with smart thermostats. Thus, the assumed electric savings for this measure should be reassessed.

Participant Satisfaction: Results from the property manager survey suggest the Multifamily Retrofit program is operating well and participants are, in general, highly satisfied with the program. Average satisfaction scores were high across all aspects of the program, ranging from 4.5 to 4.6 on a 5-point scale.

Program Outreach: Survey responses also suggest the program is doing a good job at educating contractors about the program and conducting direct outreach to property managers, which were key strategies noted during the program staff interview. Online survey results revealed that participants often found out about the program from PSE's marketing and communications (collectively 41%), including from the program website (15%), PSE's Energy Advisor (13%), or from a PSE phone call, direct mall, or email (13%). Almost a quarter (24%) found out about the program from their contractor.

Barriers to Program Participation: Property manager survey respondents cited disruptions to tenants (21%), hesitancy from tenants or other stakeholders (17%), and the time commitment or how long the project took (17%) as the primary barriers to program participation. Other commonly reported concerns or barriers included higher upfront cost or investment (16%) or program and eligibility requirements (12%).

1.5.2 Recommendations

Based on these key findings, DNV has the following recommendations:

Recommendations

Windows:

- **Addressing Low Realization Rate:** PSE should reassess the assumptions used for savings associated with windows. This should involve a closer examination of the building shell assumptions and actual usage patterns as well as a review of technical reference manuals (TRMs) from other regions.
- **Collaboration with RTF Staff:** PSE should work with staff responsible for overseeing the RTF Windows savings assumptions (i.e., modelling approaches and assumptions) and encourage a deeper review in subsequent RTF workbook revisions.

Lighting:

- **Enhance Data Collection on Usage Hours:** PSE should systematically collect operational hours of use data for common area lighting from participating sites as part of the program, which could lead to additional savings. PSE should act soon on this recommendation because the window of opportunity for claiming lighting savings in multifamily buildings in Washington is likely to close within the next few years.

Thermostats:

- **Reconsideration of Measure:** Given that smart thermostats produced limited savings, PSE should reassess continued support for this measure as part of the Multifamily Retrofit program or include it with future demand response programs aimed at multifamily buildings.
- **Collaboration with RTF:** PSE should work with staff responsible for overseeing the RTF smart thermostat savings assumptions and encourage a deeper review in subsequent RTF workbook revisions. This effort could lead to a more accurate representation of the energy savings potential of thermostats, especially if the measure is continued or integrated into other programs, such as existing or new demand response programs.

Barriers to Program Participation: PSE should consider developing a comprehensive communication plan to educate tenants about the benefits related to their participation in the program, given the primary barriers to participation were disruption to tenants and hesitancy from tenants and other stakeholders. This could include in-person presentations conducted in multifamily buildings with tenants to educate them on the energy and non-energy benefits (e.g., increase comfort) of energy efficiency upgrades.

2 INTRODUCTION

In this section, we provide an overview of Puget Sound Energy's (PSE) 2021 and 2022 Multifamily Retrofit program, research objectives, impact evaluation methods, and process evaluation methods.

2.1 Program Overview

PSE's Multifamily Retrofit program is a midstream and downstream program that offers comprehensive retrofit and strategic energy management opportunities for residential building envelope, common areas, and in-unit dwellings. Incentives are available for efficiency measures including weatherization, heating, ventilation, and air-conditioning (HVAC), controls, behavioral modifications, lighting, and appliances. The program aims to increase the installation of these measures in existing multifamily buildings by working with property owners, managers, trade ally contractors, tenants, and multifamily campuses. The 2022 program emphasized the recruitment of low income and vulnerable demographics. Direct install (DI) measures, audits, and marketing and outreach activities are implemented by a third-party contractor (CLEAResult), while common area and building envelope measures are implemented by PSE's network of contractors.[1]

2.2 Research Objectives

The primary research objective of this impact evaluation was to estimate the energy savings attributable to the Multifamily Retrofit program. The core activities included verifying the installation of measures incentivized through the program, assessing building and occupancy changes, and utilizing remote verification methods. To evaluate the energy savings, DNV employed a suite of research techniques, which included property manager surveys with remote verification to confirm the installation of energy-saving measures. Conducting the participant surveys and building staff interviews were instrumental in analyzing changes in building usage, occupancy patterns, and occupant behavior, which are critical components in assessing the efficacy of energy-saving measures. The objectives of the process evaluation were to assess program awareness, participant satisfaction, and perceived barriers to program participation. Table 2-1 provides an overview of research objectives and associated research activities for both the impact and process evaluations.

Table 2-1. Research activities and primary research objectives for Multifamily Retrofit program

Objective		Energy Modeling	Participant Online Survey	Building Staff Interviews	Remote Verification	Program Staff Interviews
Impact	Energy Savings	■			■	■
	Measure Verification		■	■	■	■
	Building Changes		■	■		
	Behavioral/Occupancy Changes		■	■		
Process	Participant Satisfaction		■	■		■
	Program Awareness		■	■		■
	Perceived Barriers		■	■		■

2.3 Impact Evaluation Overview

As mentioned in the previous section, the primary objective of the impact evaluation was to assess the combined energy savings associated with all the measures installed through the program in 2021 and 2022. To do this, evaluators identified

[1] Puget Sound Energy. Multifamily Retrofit Program: Program Guide.

the measures with the highest claimed energy savings and prioritized these measures during building manager interviews. Energy modelling was instrumental in this evaluation, pinpointing the effectiveness of HVAC upgrades and weatherization improvements. This approach facilitated the precise quantification of the energy savings attributable to these measures. For an overview of the methods used in this evaluation, please see Section 4.2.

2.4 Process Evaluation Overview

DNV designed the process evaluation to provide information on how the Multifamily Retrofit program has performed and what the customer experience with the program was like. This year's evaluation included two key activities:

1. Interview of PSE Multifamily Retrofit program staff
2. Online survey with property managers or building staff familiar with the measures installed in their buildings that received incentives through the program

DNV designed the program staff interview to understand challenges and opportunities from the perspective of PSE's program manager and the program implementers. From this interview, we were able to generate suggestions for program process improvements, a description of recent program changes, and discussion of how those changes impacted the program.

DNV sent the online survey to program participants to better understand customer awareness and satisfaction with various aspects of the program. We also focused, specifically, on questions to assess customers experience with the program, factors that may have influenced their participation and decision-making processes, and perceived barriers to program participation.

2.5 Report Overview

We have organized the remainder of this report as follows:

- **Section 3 Data Sources** describes the evaluation's data sources.
- **Section 4 Impact Evaluation Results** details the results of the impact evaluation.
- **Section 5 Process Evaluation Results** provides the results of the process evaluation.
- **Section 6 Findings and Recommendations** includes the evaluation's key findings and recommendations.
- **Appendix A: Sample Design** details the sample design used for the remote verification surveys and participant online surveys.
- **Appendix B: Impact** provides additional details on the impact evaluation results.
- **Appendix C: Additional Survey Results** includes additional tables of demographic results from the participant online survey.
- **Appendix D: Data Collection Instruments** provides the data collection instruments used for the participant online surveys, building staff interviews, and program staff interviews.

3 DATA SOURCES

This section provides the data sources used to evaluate PSE's Multifamily Retrofit program for the 2021 and 2022 program years. These data sources include tracking data, deemed savings documentation, energy consumption data, weather data, program staff interviews, telephone interviews with property managers and building staff, and online surveys with property managers and building staff. We discuss each source in the sections below.

3.1 Program Tracking Data

The program tracking data offer a detailed and comprehensive view of the program's impact on energy savings in multifamily residential buildings by measure category. This data source was integral to the retrospective evaluation, aimed at identifying the most effective energy-saving measures that had been undertaken. The detailed project-level data served as the backbone for assessing the energy-saving measures. Project-level data included extensive details on the type of buildings, their year of construction, and the various energy-saving measures implemented in each project. The dataset recorded both kWh and therm savings, along with the associated costs, providing a holistic view of the improvements in energy efficiency.

Table 3-1 summarizes the claimed electric savings for the PSE Multifamily retrofit program across 580 properties. The summary table shows the relative size of each measure in terms of the quantity installed and the total kilowatt-hours (kWh) saved. Windows led the way with the highest savings, achieving over 5 million kWh, which is 43% of the total savings. This is followed by thermostats and lighting improvements, which accounted for 22% and 20% of the total savings, respectively. The table also compares the annual savings contributions for 2021 and 2022, indicating fluctuations in the effectiveness and adoption of each measure over these years. The grand total reflects the aggregate impact of the program, totaling approximately 11.65 million kWh saved.

Table 3-1. Program tracking data 2021-2022 – claimed electric savings

Measure Category	Number of Properties 2021-2022*	Measure Quantity 2021-2022	Total kWh Savings 2021-2022	Percent of Total kWh Savings 2021-2022	Percent of Total kWh Savings 2021	Percent of Total kWh Savings 2022
Windows	163	338,968	5,043,173	43.3%	51.0%	32.8%
Thermostat	205	43,653	2,615,720	22.4%	12.5%	36.0%
Lighting	179	13,068	2,394,831	20.6%	23.2%	16.9%
Air Sealing	12	-	573,995	4.9%	5.7%	3.8%
Attic Insulation	21	479,850	291,678	2.5%	1.6%	3.7%
Flow Restrictor / Aerator	72	1,919	175,030	1.5%	2.0%	0.9%
Floor Insulation	4	103,896	140,510	1.2%	1.4%	0.9%
Fan	18	925	120,807	1.0%	1.4%	0.6%
Plug Load	122	2,643	119,015	1.0%	0.8%	1.3%
Wall Insulation	2	54,877	115,242	1.0%	0.0%	2.3%
Heat Pump	26	40	54,411	0.5%	0.2%	0.8%
Clothes Washer	7	162	4,908	0.0%	0.1%	0.0%
Water Heater	4	4	2,405	0.0%	0.0%	0.0%
Clothes Dryer	6	6	408	0.0%	0.0%	0.0%
Total	**580***	**1,040,011**	**11,652,132**	**100.0%**	**100.0%**	**100.0%**

* Note, the sum of this column does not add up to the total number of unique properties with electric claims in the program (580). This is because some number of sites installed multiple measures, so summing the values in this column would double count many sites, resulting in a total that is larger than the actual population of properties in the program.

Table 3-2 presents a summary of gas savings by measure category for the 2021-2022 program years. As was the case with electric savings, windows stand out as the most impactful gas savings measure, with installations at 11 properties totaling 30,000 therms saved. This represents 63.9% of the total therms saved, with a notable 82% contribution in 2021 and a sharp decline to 13% in 2022. Attic insulation accounted for 18% of the total gas savings across 2021 and 2022, increasing to 70% of all therm savings in 2022, indicating a significant increase in its impact on gas savings.[2] Other measures, such as boilers and integrated heating systems, show smaller but still notable contributions to total gas savings. The grand total reflects the cumulative gas savings across all measures, achieving 46,940 therms saved across 38 properties.

Table 3-2. Program tracking data 2021-2022 – claimed gas savings

Measure Category	Number of Properties 2021-2022	Measure Quantity 2021-2022	Total Therm Savings 2021-2022	Percent of Total Therm Savings 2021-2022	Percent of Total Therm Savings 2021	Percent of Total Therm Savings 2022
Windows	11	26,240	30,000	63.9%	82.4%	12.7%
Attic Insulation	4	286,028	8,653	18.4%	0.0%	69.6%
Boiler	5	-	6,299	13.4%	14.8%	9.6%
Integrated Heating System	7	7	968	2.1%	1.6%	3.3%
Furnace	4	4	435	0.9%	0.6%	1.7%
Wall Insulation	1	2,301	230	0.5%	0.0%	1.9%
Water Heater	4	4	205	0.4%	0.2%	1.0%
Clothes Washer	1	156	125	0.3%	0.4%	0.0%
Flow Restrictor / Aerator	1	11	24	0.1%	0.0%	0.2%
Total	**38**	**314,751**	**46,940**	**100.0%**	**100.0%**	**100.0%**

3.2 Deemed Savings Documentation

DNV conducted a thorough review of the Regional Technical Forum (RTF) measure case documentation to gain an in-depth understanding of the inputs, assumptions, and calculations behind the RTF deemed savings. The findings from this review of each measure case are summarized below. The savings values in the RTF analysis workbooks matched the tracking data savings for all measure cases.

- **Window:** The savings for single, double, and triple pane windows were derived from adjustments to the U-value and solar heat gain coefficients (SHGC). The “ResMFWeatherization_v4_2.xlsm” source workbook provided a table detailing these adjustments. For instance, retrofitting included upgrading a single pane window to double pane. This upgrade changed the RTF’s window baseline U-value from 1.09 to 0.29, significantly improving insulation. It also reduced the Solar Heat Gain Coefficient (SHGC) from 0.75 to 0.3, enhancing the window's efficiency in blocking heat from the sun. Similarly, retrofitting double pane windows to triple pane (U22) were noted, further optimizing efficiency.
- **Boiler:** The boiler savings calculations and inputs, as found in the “Boiler_SoS_2022-ACH.xlsx” workbook, primarily hinged on the difference in the annual fuel utilization ratio (AFUE) between the ENERGY STAR qualified unit (95% AFUE) and the baseline conventional unit (84% AFUE). The calculations also factored in a heating load of 28.6 kBtu/sq ft/yr for a 2,488 sq ft home.

[2] We should note that measures are selected on a project by project basis and due to the relatively low number of gas projects, there can be considerable fluctuations in the mix of measures between program years.

- **Lighting Fixtures:** The review covered the replacement of 4ft linear T8 and T12 fluorescents with TLEDs. Detailed descriptions and wattages for existing and new cases are listed in the "PSE MultiFamily Lighting STANDARD.xlsx" workbook. Savings for these lighting fixtures were based on a wattage reduction from 59W to 30W for T8 replacements and from 75W to 30W for T12 replacements.
- **Thermostats:** The analysis included two types of thermostats — Electronic Line Voltage Thermostats (ELVT) and Line Voltage Communicating Thermostats (LVCT). Both types featured seven-day programmable scheduling, Wi-Fi or bridge connectivity for remote access, and used outdoor air temperature sensors or internet weather data. The energy savings for these thermostats were estimated based on the average zonal electric energy use from the Residential Building Stock Assessment (RBSA) I and RBSA II household studies and calculated as a percentage of electric heating energy saved, with ELVTs at around 5% and LVCTs at approximately 6%, following the assumptions from the April 2016 and 2019 RTF presentations and the Hydro Quebec study.[3] We discuss this further in Section 4.4.4.
- **Attic Insulation:** The RTF attic insulation savings are based on insulation R-values prescribed in the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Handbook of Fundamentals 2013. The RTF prototype house weightings were used with the calibrated "Simplified Energy Enthalpy Model" (SEEM) engine to generate heating energy use for both baseline and efficient cases. Baseline R-values range from 8.5 to 30.4 and efficient R-values range from 18.8 to 34.7. The values in the RTF workbook aligned with values verified in the tracking data.

3.3 Consumption and Weather Data

The impact evaluation involved an analysis of energy consumption patterns in relation to specific climatic conditions. This section provides an overview of the data sources for energy consumption and weather data, and how these were used in the evaluation process.

Energy Consumption Data:

- **Data Source:** The primary source for energy consumption data was PSE's utility records, encompassing detailed statistics on both electric and gas usage in multifamily residential buildings within PSE's service territory. This data was critical for understanding the energy consumption patterns in these buildings.
- **Utilization in Evaluation:** This consumption data was pivotal in establishing the baseline energy use against which effectiveness of the energy-saving measures was assessed. By analyzing energy usage before and after implementation of these measures, we were able to estimate actual energy savings realized through the program.

Weather Data:

- **Data Source:** DNV integrated ASHRAE climate data for Climate Zones 4B and 4C, relevant to PSE's service territory, into our analysis. This data is essential for understanding climatic conditions specific to the area.
- **Utilization in Evaluation:** Weather data was crucial for adjusting the energy consumption data to account for seasonal and climatic variations. This adjustment enabled a more precise estimation of energy savings by considering the impact of weather on energy consumption trends. DNV analyzed the correlation between energy usage and varying weather conditions to understand how climatic differences affect energy consumption over time.

The combination of energy consumption data with weather data allowed for the development of a sophisticated framework to assess energy savings, considering the unique climate characteristics of the buildings within PSE's service territory. The

[3] Opinion Dynamics. 2017-2018 Web-Enabled Thermostats Program Impact and Process Evaluation Report. Puget Sound Energy, 2019.

specific methods and findings that arose from the application of this data are elaborated in other parts of the report, particularly in the sections discussing the methodology and results of the impact evaluation.

3.4 Program Staff and Implementer Interview

The program staff and implementer interview took place in July 2023 and included key staff from PSE's implementer, CLEAResult, and the PSE Multifamily Retrofit program manager. The interview sought to gain insights into various aspects of the program, including recent and planned program changes, marketing and outreach efforts, communication with property managers, quality control processes, participation barriers, program growth potential, and identification of any missed savings opportunities. We provide further details on insights gained from this interview in Section 5.1 Insights from Program Staff and Implementer Interview.

3.5 Property Manager Telephone Survey

The property manager telephone surveys gathered detailed information and insights into the program's implementation and impact. The survey was divided into several sections, each addressing specific aspects of the program and the property managers' experiences with it.

- **Screener and Verification:** The first section served as a screener to confirm the respondent's familiarity with upgrades made to a specific property and their role in the decision-making process. This was crucial to ensure the relevance and accuracy of information collected. The next section included a verification phase where respondents were asked to confirm building details such as the building type, number of units, year built, and the specific energy-saving measures installed. This step was essential to validate the accuracy of the program's tracking data against the respondents' first-hand knowledge.
- **General Property/Measure Questions:** This segment delved into more specific property details including total square footage, number of floors, and the year built, if not previously mentioned. Questions also probed into the types of heating and cooling systems used, their age, maintenance routines, types of thermostats, and the percentage of common area lighting that remained on continuously. This section gathered context about the property's infrastructure and maintenance, which could influence the effectiveness of energy-saving measures.
- **Program Outreach and Participation:** These sections explored how property managers learned about the program, the challenges faced in installing the program measures, and the primary and secondary factors influencing their decision to participate. This provided insights into the program's marketing and outreach effectiveness and the motivations behind participants' engagement. Questions about overall experience, equipment offerings, and the perceived impact on energy savings and cost reduction offered a qualitative assessment of the program's success from the participants' perspective.
- **Program Experience and Satisfaction:** This final section delved deeper into the participants' experiences, asking whether they would have installed the same level of equipment without the incentives, what alternatives they might have considered, and the types of information provided by the program. This section aimed to understand the program's influence on decision-making and to gather feedback on the information dissemination and support provided by the program.

The property manager telephone survey was strategically designed to target 60 multifamily residential sites. Table 3-3 shows the final disposition from the property manager telephone survey. DNV completed 48 telephone surveys, which represents 80% of the intended target of 60 completed surveys. Among the primary sample sites, 47 were uncontactable due to outdated or incorrect contact information and 18 sample points refusal to participate.

Table 3-3. Property manager telephone survey disposition

Disposition	Sites
Left message	56
Sent email	79
Bad contact info	47
Declined	18
Call back	7
Scheduled	2
Complete	48
Total	**258**

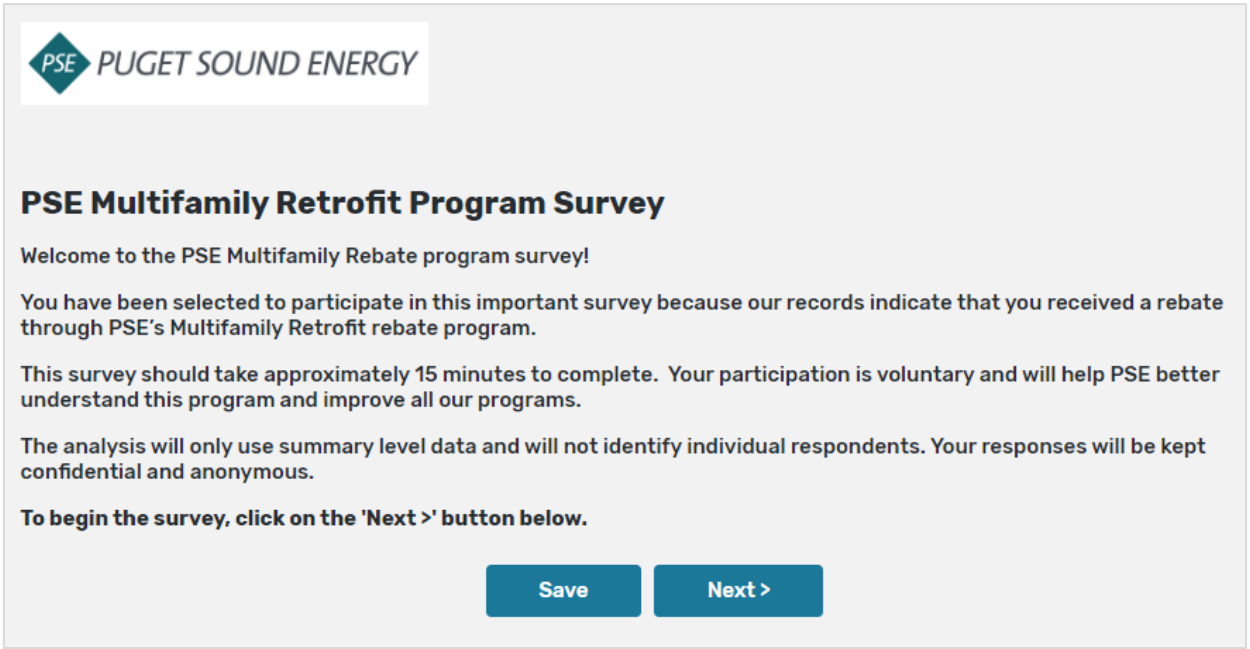
3.6 Property Manager Online Survey

The property manager online survey contained the process-related survey questions from the property manager telephone survey discussed in Section 3.5. The intent of this survey was to assess the participant experience and included questions on program awareness, program satisfaction, barriers related to program participation, and reasons for participation. The online survey invitation was delivered via email to the entire population of program participants who had not responded to the telephone survey at the time of the online survey launch (September 18, 2023) and included the following features:

- The survey was preceded by a research bulletin alerting customers of the upcoming survey.
- The survey was branded with a PSE logo on the landing page.
- To motivate respondents to participate in the online survey, we held a lottery that offered two e-gift cards incentives of $300 and $200. Respondents who completed the survey were eligible to win one of the prizes, and therefore included in the gift card lottery.
- All respondents were provided the option to opt-out of the survey and opt-out of the gift card lottery.

Figure 3-1 shows the landing page participants view upon accessing the survey.

Figure 3-1. Property manager online survey landing page



The survey was launched on September 18th, 2023 and remained open until September 29th, 2023. Non-respondents received up to three reminder emails to complete the survey. Table 3-4 shows the number of completed surveys and response rate. The overall reponse rate was 6%.

Table 3-4. Online survey completes and response rates

Survey Population*	# of Completes	Response Rate
332	20	6%

* When preparing the online survey, DNV removed participants from the Property Manager Telephone survey population who either: a.) already responded to the on-going telephone survey effort or b.) declined to participate in the telephone survey.

4 IMPACT EVALUATION RESULTS

This section presents the detailed results of the impact evaluation, which includes a comprehensive overview of the evaluated savings and realization rates for energy-saving measures implemented through the program. The evaluation methodology encompassed the verification of installed measures and an in-depth analysis of the savings achieved.

4.1 Results Overview

The impact evaluation assessed the energy savings of the program overall and savings associated with specific measure categories within the program. We also calculated the realization rate for the program overall and realization rates for measure categories by dividing the program or measure category's reported (claimed) savings by the evaluated savings.

4.1.1 Program's Realization Rate

The program achieved an overall realization rate of 88%. Nearly 90% of program's reported energy savings were electric savings and 11% were gas savings. Thus, our approach to the impact evaluation focused primarily on measures that achieved electric savings.

4.1.2 Measure-Specific Realization Rates

To understand the performance of individual measures within the program, we calculated the realization rates for measure categories that received incentives through the program. These rates provide insights into how the evaluated savings compared to the claimed savings for each type of measure.

- **Windows:** The Windows category had a realization rate of 45% (combined electric and gas savings), indicating a notable difference between reported and evaluated savings for this measure.
- **Envelope:** The Envelope measures exhibited a higher realization rate of 213% (combined electric and gas savings). This rate indicates that the evaluated savings for envelope improvements substantially exceeded the claimed savings.
- **Lighting:** For Lighting, the realization rate was 145% (electric savings), reflecting that the evaluated savings surpassed the reported savings.
- **Thermostats:** Due to project file and consumption data limitations, the thermostat measures reported savings were confirmed as installed during telephone interviews with property managers and passed through resulting in a realization rate of 100% (combined electric and gas savings).
- **Other Measures:** Because the "Other Measures" category represented a diverse array of measures that collectively represented only 5% of total program savings, we confirmed installation of measures in this category in phone interviews and conducted an engineering reviewed of the deemed savings assumptions for these measures. We determined that the savings assumptions for these measures were reasonable and passed through reported savings. This resulted in a realization rate of 100% (electric savings).

4.1.3 Detailed Savings Analysis

Table 4-1, Table 4-2, and Table 4-3 provide a detailed breakdown of the claimed savings, evaluated savings, and realization rates for each measure category, in MMBtu, kWh, and therms. The tables also show the precision of realization rates, the completed sample size, and the total population for each measure category.

Table 4-1. Measure-level claimed savings, evaluated savings and realization rate (MMBtu)

				Realization Rate Precision				
Measure Category	Reported Savings	Evaluated Savings	Realization Rate	90% CI Low	90% CI High	Relative Precision	Completed Sample	Population
Windows	20,207	9,089	45%	0.42	0.48	0.07	23	329
Envelope	4,715	10,032	213%	1.87	2.39	0.12	3	97
Lighting	8,171	11,882	145%	0.98	1.93	0.32	9	144
Thermostat	8,925	8,925	100%	-	-	- *	12	537
Other	2,433	2,433	100%	-	-	-	1	22
Total	**44,451**	**38,914**	**88%**	**0.72**	**1.03**	**0.17**	**48**	**1,129**

* The reported 100% realization rate for thermostat savings is a result of the savings being 'passed through' rather than being derived from a detailed modelling analysis. Passing through the savings with a 100% realization rate for each sample site results in an estimate of savings for this measure that is artificially precise because there is no variability between sample points Accordingly, the relative precision for Thermostats is presented as undefined.

Table 4-2. Measure-level claimed savings, evaluated savings, and realization rate (kWh)

				Realization Rate Precision				
Measure Category	Reported Savings	Evaluated Savings	Realization Rate	90% CI Low	90% CI High	Relative Precision	Completed Sample	Population
Windows	5,043,173	2,213,945	44%	0.41	0.47	0.07	22	329
Envelope	1,121,424	2,386,154	213%	1.87	2.39	0.12	3	97
Lighting	2,394,831	3,482,314	145%	0.98	1.93	0.32	9	144
Thermostat	2,615,720	2,615,720	100%	-	-	-	12	537
Total	**11,175,148**	**9,853,491**	**88%**	**0.72**	**1.04**	**0.18**	**46**	**1,107**

Table 4-3. Measure-level claimed savings, evaluated savings, and realization rate (therms)

				Realization Rate Precision				
Measure Category	Reported Savings	Evaluated Savings	Realization Rate	90% CI Low	90% CI High	Relative Precision	Completed Sample	Population
Windows	30,000	13,494	45%	0.42	0.48	0.07	23	329
Envelope	8,883	18,901	213%	1.87	2.39	0.12	3	97
Other	8,057	8,057	100%	-	-	-	1	22
Total	**46,940**	**29,703**	**63%**	**0.44**	**0.83**	**0.31**	**27**	**448**

4.2 Methods Overview

DNV used multiple methods to assess energy savings associated with measures incentivized by the program. A critical input was verifying the installation of program measures via telephone surveys with property managers.

DNV crafted the sample strategy to ensure a robust representation of the population of buildings and measures installed at those buildings. Stratified sampling was employed to accurately reflect the diversity and distribution of the measures. The sample targets were established based on the population of each measure within its respective stratum, with the actual sample completion documented to ensure the integrity and representativeness of the data. For specific methodologies applied to each measure type, please see Section 4.4. We provide more details on the sample design in Appendix A: Sample Design and the assumptions used in the impact evaluation in Appendix B: Impact Evaluation Assumptions.

4.3 Verification Results

The installation rate of measures installed through the program was approximately 95%. The installation rate was informed by telephone interviews with property managers during which evaluators asked questions to remotely verify the installation and continued use of the measures. This process ensured that the installation data was directly sourced from those overseeing the implementation at each property.

Property manager phone interviews revealed that most respondents, typically the decision-makers for their properties, were knowledgeable about their participation in the program. This indicates effective targeting from the program's marketing and outreach efforts. Property managers were able to provide detailed building-specific information, including building type, the number of units, and the year of construction, affirming the accuracy of the program's record-keeping. They also demonstrated an awareness of the energy-saving benefits of the installed measures, highlighting the program's success in communicating its objectives and outcomes. Finally, the willingness of a majority of respondents to engage in follow-up communications signals ongoing engagement with the program.

Despite these positive aspects, property managers also reported encountering challenges, particularly with installation logistics and tenant coordination. These issues were identified as potential areas for improvement in the program's execution. A more detailed summary of the program barriers is detailed in Section 5.5.

4.4 Evaluated Savings Results by Measure

The sections below detail the results of the impact evaluation for the major measure categories included in the program. These measure categories include windows, envelope, lighting, thermostats, and other measures. We provide further details on evaluated energy savings and how we calculated savings in each subsection below.

4.4.1 Windows

DNV completed surveys with property managers who oversaw the installation of windows at 23 sites out of a population of 329 sites with windows. Evaluated savings for windows was 9,089 MMBtu, which is substantially lower than the 20,207 MMBtu savings that the program claimed, resulting in a realization rate of 45% for windows. The lower realization rate is mostly attributable to an overestimation of windows savings in the RTF's assumptions for windows savings.

Table 4-4. Window measure savings

Measure Category	n	N	Reported Savings (MMBtu)	Evaluated Savings (MMBtu)	Realization Rate
Windows	23	329	20,207	9,089	45%

A critical part of our analysis involved a comparative study with findings from other technical reference manuals (TRMs), specifically the Illinois TRM and the California Municipal Utilities Association's publicly owned utilities (POU) TRMs. The PSE evaluated savings results from single to double plane replacements and single to triple pane replacements shown in row two of Table 4-5 are similar to the savings reported in the Illinois TRM and the California POU's TRMs shown in rows three and four. This comparison contextualizes the impact evaluation findings for windows. It reveals that both the evaluated savings in our study and those in the benchmark TRMs are less than half of the savings claimed by the PSE suggesting that the RTF savings may be in error.

Table 4-5. Window savings comparison using single pane window baseline

Source	Climate Zone	Heating Degree Days (HDD)	Cooling Degree Days (CDD)	Triple Pane Savings (kWh)	Double Pane Savings (kWh)
PSE Claimed	IECC 4B and 4C	Unknown	Unknown	27	24
PSE Evaluated	IECC 4B and 4C	4,800	200	7.7	9.5
Chicago[4]	IECC 5A	5,250	500	8.27	
CA Sierra Mountains[5]	CA CZ15	5,057	596		8.0

Our methodology in this analysis included updating certain assumptions (Appendix B: Impact Evaluation Assumptions) based on customer surveys. The U-value and SHGC for the PSE claimed savings for windows were documented in the RTF, and we used the same values in our model. These updates encompassed variables like the heating system type, the number of floors in the buildings, and their respective climate zones. In modelling these factors, we primarily considered electric baseboard heating with packaged terminal air conditioner (PTAC) cooling, except for one site which utilized a gas furnace. As would be expected, higher savings were consistently found in colder climates and in taller buildings.

4.4.2 Envelope

The evaluation of envelope measures involved modelling the impact of upgrades to the building's thermal envelope to enhance energy efficiency. This assessment specifically focused on improvements such as attic insulation, air sealing, wall insulation, and floor insulation. However, it should be noted that, within the scope of this analysis, only attic insulation was modeled in detail due to this measure group making up the majority of the reported envelope energy savings. The realization rate results for attic insulation were applied to the other envelope measures. The assumptions for attic insulation modeling are discussed in the Appendix B: Envelope Measure Assumptions.

As shown in Table 4-6, our study focused on a subset of three envelope sites out of a larger population of 97 sites. The reported savings from these measures totaled 4,715 MMBtu. However, the evaluated savings for these envelope measures amounted to 10,032 MMBtu and a realization rate of 213%. The realization rate of 213% could be due to a variety of factors, including building geometry, the complexity of accurately modelling the dynamics of thermal exchange, the variations in building construction and usage patterns. Furthermore, given the fact that this measure represented about 11% of program savings overall, we targeted a limited number of sites (seven) and completed interviews with property managers representing three sites. The higher realization rate could also be attributable to the small number of achieved sample points. The findings from this evaluation indicate that envelope measures play a role in energy conservation strategies, especially in regions with significant heating and cooling demands.

Table 4-6. Envelope measure savings

Measure Category	n	N	Reported Savings (MMBtu)	Evaluated Savings (MMBtu)	Realization Rate
Envelope	3	97	4,715	10,032	213%

[4] Source is Climate Zone 2 (Chicago) in Table 5 on page 434 of the Illinois Technical Reference Manual, 2023 https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010123_v11.0_Vol_3_Res_09222022_FINAL.pdf

[5] Savings source is Climate Zone 16 in Energy Savings Table 12.7.1 in the California POU Technical Reference Manual, 2017 https://www.cmua.org/files/CMUA-POU-TRM_2017_FINAL_12-5-2017%20-%20Copy.pdf

4.4.3 Lighting

To gain a more precise estimate of savings attributable to lighting measures, we collected site-specific information in surveys with property managers. A key component of our analysis was the estimation of the annual operational hours for lighting fixtures. We specifically focused on the proportion of common area lighting that was operating continuously 24 hours per day every day of the week. Notably, three out of the four surveyed sites indicated that between 30% to 100% of their common area lighting remains on continuously, a stark contrast to the RTF's assumption of a 25% operational time. This discrepancy highlights the importance of site-specific data in accurately assessing energy savings.

DNV's analysis of the lighting category, covering 9 sampled sites out of a total of 144 (see Table 4-7), revealed reported savings of 8,171 MMBtu and evaluated savings of 11,882 MMBtu, resulting in a realization rate of 145%.

Table 4-7. Lighting measure savings

Measure Category	n	N	Reported Savings (MMBtu)	Evaluated Savings (MMBtu)	Realization Rate
Lighting	9	144	8,171	11,882	145%

4.4.4 Thermostats

DNV attempted to evaluate the thermostat measure with an energy modelling approach to assess the measure's impact on electric and gas savings. The evaluation of the thermostat measure presented unique challenges, especially in quantifying the precise savings for the measure. Our approach to the analysis was guided by two main factors: the available project and consumption data and methodological constraints. The consumption data could not be disaggregated to the level of treated and untreated units among the participating buildings and there were issues with the accuracy of some addresses within the project files, particularly for the 2021 program year, which impacted our ability to conduct a detailed billing consumption analysis to evaluate savings for the measure.

The realization rate for the thermostat measure is 100% (Table 4-8). As noted above, there were data limitations which affected our ability to confidently assess the measure's impact. To accurately evaluate savings for the smart thermostat measure, we would normally conduct a billing consumption analysis, which would involve an analysis of the buildings with the smart thermostats installed through the program against a matched comparison group of similar buildings and units without the measure to serve as a counterfactual. This type of analysis was not possible given the gaps in consumption data for specific units, issues with the accuracy of some addresses within the project files, and the significant challenges of identifying a multifamily comparison group in non-participating multifamily buildings without smart thermostats. An examination of the RTF assumptions revealed a deemed savings value of 5% for smart thermostats. A recent evaluations of smart thermostat savings in California, [6] which included a large share of smart thermostats installed in multifamily units, and prior evaluations for PSE's single-family homes with smart thermostats have shown that the 5% savings assumption is too high.[7] [8] [9] Multiple studies indicate that smart thermostats are not effective at delivering annual electric savings and deliver gas savings that are far lower than expected.[10] Given the challenges of evaluating the impacts of this measure in multifamily buildings and its relatively small per unit savings, PSE should weigh the cost-effectiveness of continuing to incentivize the measure. The most effective way to reduce the uncertainty around savings estimates of this measure would be to conduct a

[6] DNV, Impact Evaluation of Smart Thermostats – Residential Sector – Program Year 2019. Jun 16, 2021; 2019 Smart Thermostat Evaluation (calmac.org)

[7] DNV GL, Impact Evaluation of PSE Web-Enabled Thermostat Program. August 2015.

[8] Opinion Dynamics, Puget Sound Energy 2017-2018 Web-Enabled Thermostats Program Impact and Process Evaluation Report. November 20, 2019

[9] DNV, Smart Thermostat Program Final Report: 2022-2023 Impact and Process Evaluation. Forthcoming in 2024.

[10] A. Brandon et al. The Human Peris of Scaling Smart Technologies: Evidence from Field Experiments. National Bureau of Economic Research. September 2022. https://www.nber.org/system/files/working_papers/w30482/w30482.pdf

more robust study focused on this measure specifically. However, conducting this type of study is costly and might not be worth doing given that studies have consistently shown that smart thermostats do not deliver the energy savings that their manufacturers claim.

Table 4-8. Thermostat measure savings

Measure Category	n	N	Reported Savings (MMBtu)	Evaluated Savings (MMBtu)	Realization Rate
Thermostats	12	537	8,925	8,925	100%

4.4.5 Other Measures

The “Other Measures” category, which includes a variety of measures such as plug load control, clothes washers and dryers, and hot water management, accounted for only 5% of total program savings. Given the diversity of measures in this category and the fact that only one measure from it was sampled, the claimed savings for these measures were accepted as reported. DNV engineers also reviewed the deemed savings assumptions for these measures and found them to be reasonable. As such, “Other Measures” have a 100% realization rate (Table 4-9).

Table 4-9. Other measures savings

Measure Category	n	N	Reported Savings (MMBtu)	Evaluated Savings (MMBtu)	Realization Rate
Other Measures	1	22	2,433	2,433	100%

5 PROCESS EVALUATION RESULTS

This section summarizes the findings for the Multifamily Retrofit process evaluation and includes recent and planned program changes as well as the results from the program staff interview and property manager participant surveys.

5.1 Insights from Program Staff and Implementer Interview

The program staff and implementer interview included key staff from PSE's implementer, CLEAResult, and the PSE Multifamily Retrofit program manager. The interview provided a comprehensive overview of the program's operations, challenges, and future directions. The staff's responses revealed a proactive and adaptive approach to managing the Multifamily Retrofit program, with a strong focus on continuous improvement and maximizing energy savings. We provide details below on various aspects of the program, including recent and planned program changes, marketing and outreach efforts, communication with property managers, quality control processes, participation barriers, program growth potential, and identification of any missed savings opportunities.

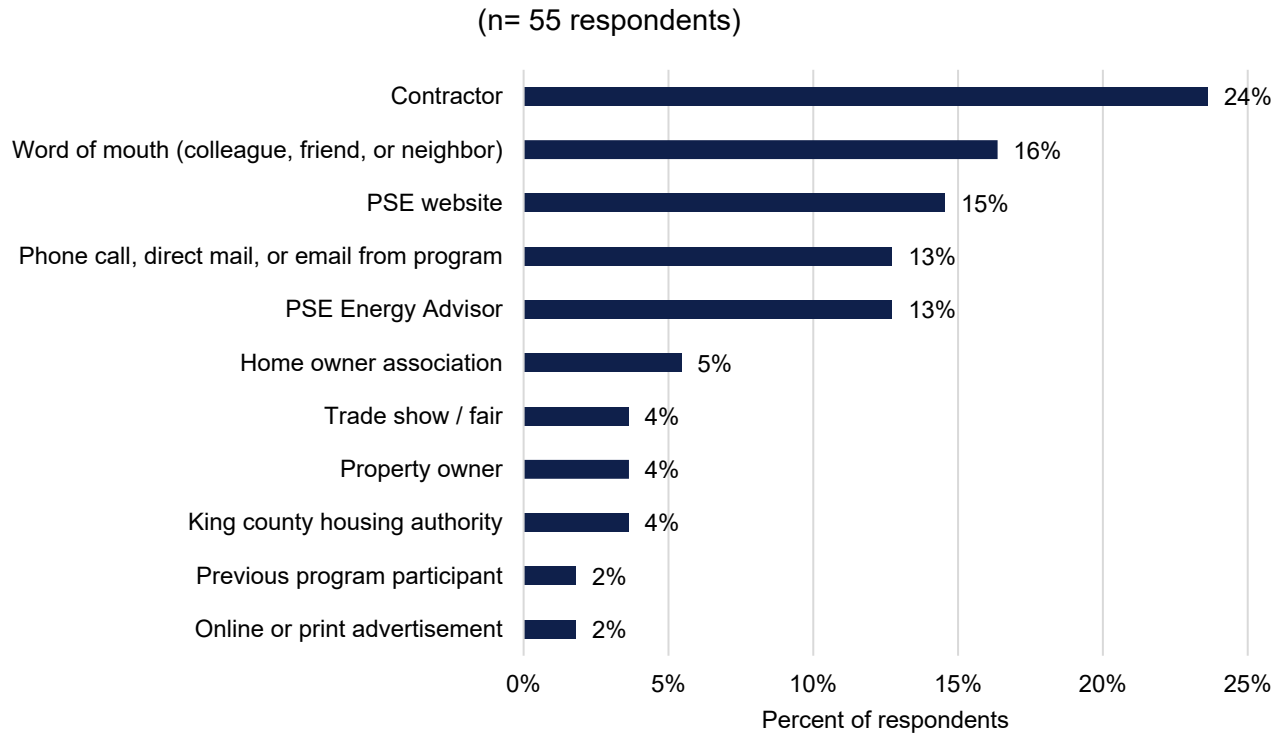
1. **Program Changes and Responsibilities:** The staff discussed recent changes, especially noting a shift from window installations to attic insulation in 2022 due to supply chain issues. The implementer focused primarily on direct installation of in-unit measures like LEDs, while contractors handled common area and building envelope measures. The conversation also touched on the increased rebates for windows and insulation and potential changes for future program iterations.
2. **Marketing and Outreach Efforts:** The team described their multifaceted marketing and outreach strategies, which included collaborations with industry associations and digital marketing efforts. They emphasized working closely with contractors and direct install teams to engage property managers and promote program measures. The staff also mentioned the importance of aligning their outreach with program savings goals.
3. **Communication and Participant Interaction:** Communication with program participants was highlighted as a key aspect, with strategies ranging from events to direct emails and phone calls. The staff noted the challenge of reaching the right decision-makers due to high turnover and the diverse nature of property managers.
4. **Quality Control and Savings Estimation:** The team outlined their rigorous quality control processes, which varied based on the type of measure and included both onsite inspections and percentage-based verifications. They discussed the methodologies used for estimating savings and the adjustments made to align with real-world conditions.
5. **Barriers to Participation:** Various barriers to participation were identified, such as difficulties with condominium associations, challenges in accessing units, COVID-19 impacts, and the high costs of certain measures like window replacements. The team acknowledged the need for continued engagement and overcoming these barriers to enhance program participation.
6. **Program Growth and Potential:** The staff shared insights on the program's success rate and efforts to boost participation, including increased rebates and promoting comfort and cost-saving benefits. They estimated that about 60% of the potential market had been served and were looking to recruit additional participants.
7. **Missed Savings Opportunities:** When asked about missed savings opportunities, the staff felt they were capturing most of the potential savings but remained open to new ideas. They mentioned looking into standalone fourplexes and new measures like micro heat pumps.

5.2 Awareness

DNV assessed the awareness of PSE's Multifamily Retrofit program by asking respondents if they were familiar with their participation in the program, and if so, where they first heard about the program. All respondents except for one (98%) were aware of their participation in the program.

As shown in Figure 5-1, many property managers found out about the program from PSE's marketing and communication efforts (collectively 41%), such as from PSE's website (15%), PSE's Energy Advisor (13%), or from a PSE phone call, direct mall, or email (13%). Almost a quarter (24%) found out about the program from their contractor.

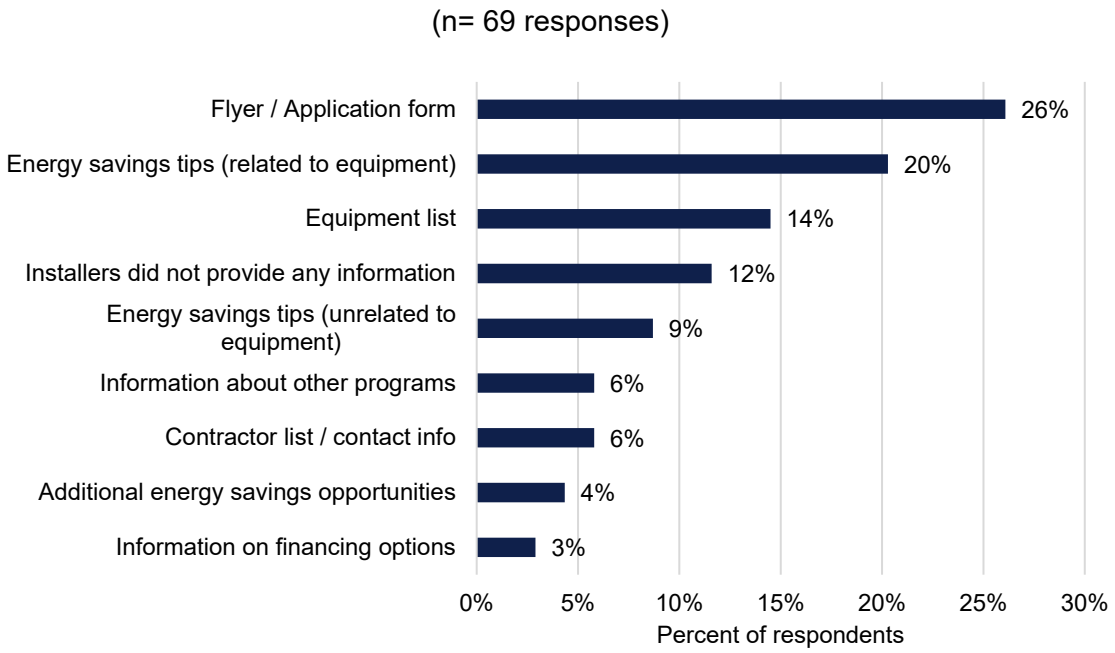
Figure 5-1. Source of program awareness



5.3 Program Experience and Satisfaction

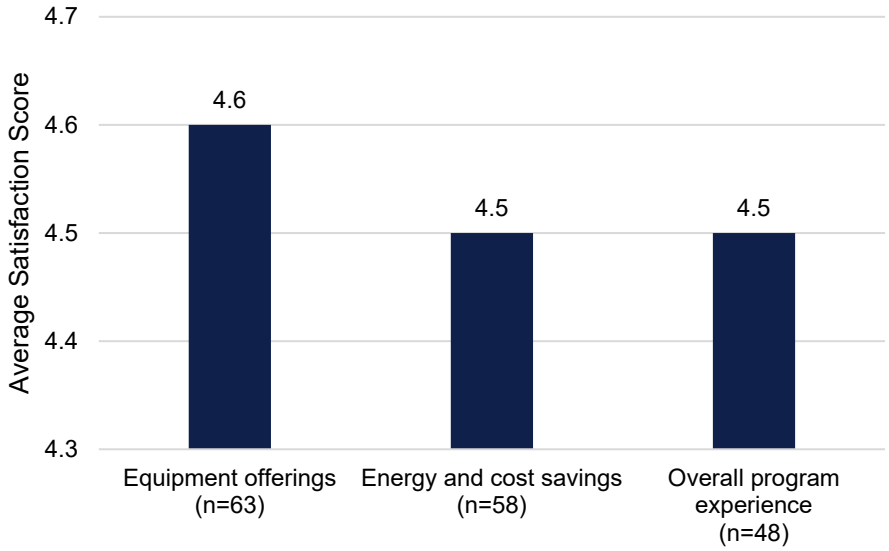
Program experience and satisfaction were evaluated by first asking property managers what kind of information they were provided when participating in the Multifamily Retrofit program (Figure 5-2). Survey respondents reported most frequently receiving a flyer or application form (26%), with slightly fewer stating that they received energy savings tips related to the program-rebated equipment (20%) or a list of equipment that was installed (14%). Only a small portion of respondents said they had received energy saving tips unrelated to the program-rebated equipment (9%), information about other program (6%) or additional energy savings opportunities (4%). These results indicate potential for further engagement with property managers about other opportunities for additional energy savings.

Figure 5-2. Information program provided to program participants



Property managers were also asked to rate their satisfaction with different aspects of the Multifamily Retrofit program using a 5-point scale, where "5" means "very satisfied" and "1" means "very dissatisfied." All three aspects of the program shown in Figure 5-3 have average satisfaction scores of 4.5 of above, which indicates a high level of participant satisfaction. On average, survey respondents reported the highest level of satisfaction with the program's equipment offerings (4.6), with only a slightly lower average satisfaction associated with their energy and cost savings resulting from their program participation (4.5) and their overall program experience (4.5). Two of the property managers expressed dissatisfaction related to their thermostats not working and one expressed concern about the "poor quality" windows, although most respondents were very satisfied with the equipment offerings and overall program experience.

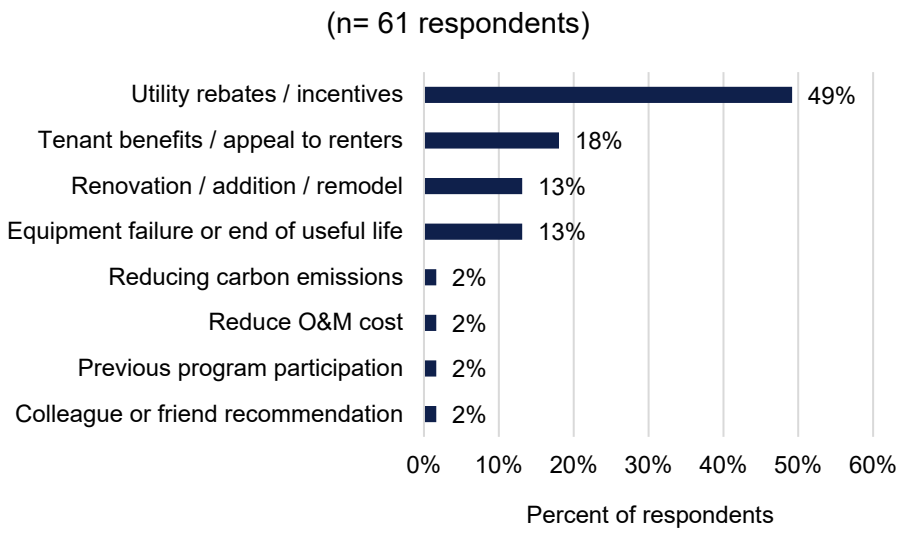
Figure 5-3. Average satisfaction ratings among property managers



5.4 Reasons for Program Participation

DNV also asked program participants various questions about the reasons for their participation in the Multifamily Retrofit program. We first asked survey respondents what their primary reason was for participating in the Multifamily Retrofit program. Almost half (49%) stated utility rebates / incentives were the primary driver for their participation, with 18% citing tenant benefits or appeal to renters. Just over a quarter of survey respondents said the primary reason they participated was due to a renovation, addition, or remodel (13%) or due to having equipment that was failing and reaching the end of its useful life (13%). A comprehensive list of the reasons for participating in the program are detailed in Figure 5-4.

Figure 5-4. Primary reason for participating in Multifamily Retrofit program

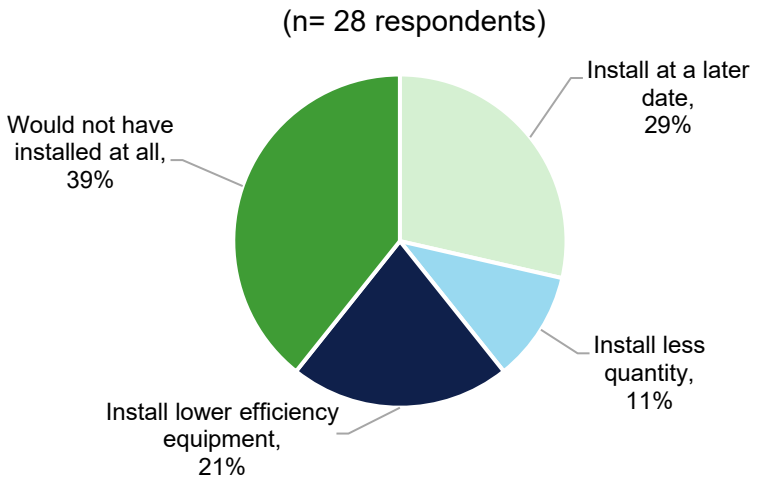


Program participants were also asked if they would have installed the equipment with the same levels of efficiency without the incentives. Just over half (53%) of the respondents stated they would have not installed equipment of the same efficiency without the incentives, with the remaining 47% reporting that they would have installed the same equipment with or without incentives. This indicates a relatively high free-ridership among program participants. Although high levels of free-ridership may not be desirable, it does not negatively affect gross realization rates or claimed savings. As noted in the Evaluation Framework, “Consistent with condition (8) (a) of UTC Order 1 approving PSE’s 2022-2023 Biennial Conservation Plan, PSE does not estimate net savings for a program or portfolio since the Net-to-Gross ratio is set at 1.0 for cost effectiveness analysis. However, the Company will examine program spillover and free-ridership when it is feasible to do so for program design purposes.”[11]

Survey respondents who said they would not installed the same equipment without incentives were then asked what they would have done. Figure 5-5 shows how over two thirds (68%) of respondents would have not installed anything at all (39%) or installed the equipment at a later date (29%). The remaining respondents would have either installed lower efficiency equipment (21%) or installed a smaller amount of equipment without the rebates.

[11] Puget Sound Energy. Evaluation, Measurement, and Verification Framework: Exhibit 6, Supplement 1. November 1, 2023. https://apiproxy.utc.wa.gov/cases/GetDocument?docID=9&year=2023&docketNumber=230893

Figure 5-5. What participant would have done without incentives



Lastly, program participants were asked what would encourage more property managers to participate in energy efficiency programs aside from incentives. Provided are the verbatims captured from the survey that reflect the following key themes:

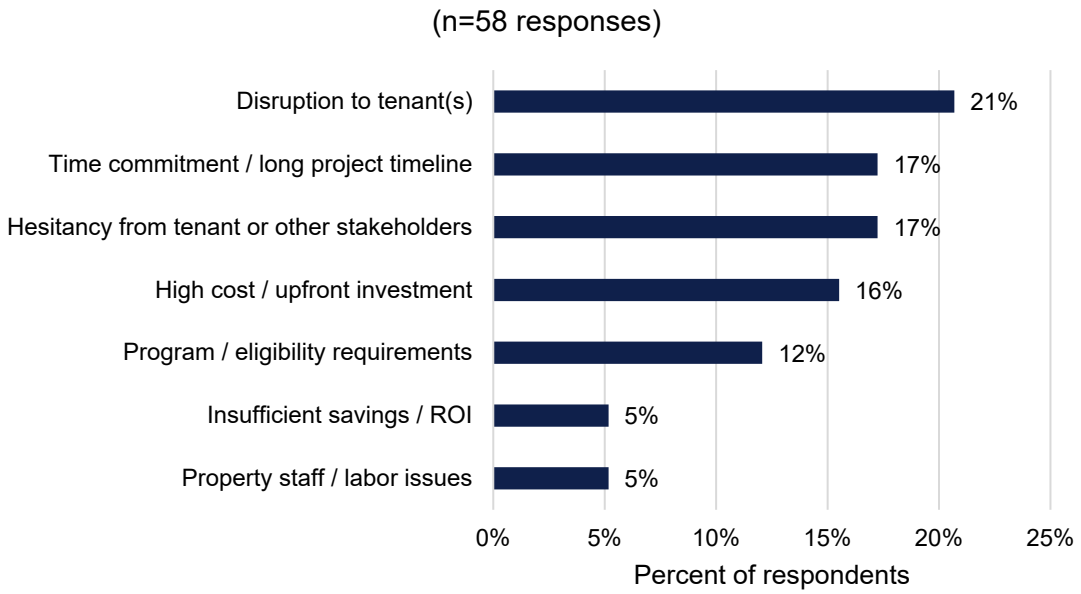
- **Marketing and outreach**
  - "It would be nice to be notified on the PSE website where I pay my bill. If they had something there, I would read it. Also recommend direct email to customers; I always read my PSE emails. They should email info to realtors so that they can mention programs available when showing houses."
  - "Just let them know it's available. I would put the info on the monthly bill."
  - "They need better communication. I just got an email from PSE about a rebate for installing chargers in buildings for electric cars. That worked great. PSE has our emails; they should send emails informing about current and future programs."
  - "More advertisement directly to the landlords, either text messaging or direct mail. It's a great program. They would use it if they knew about it."
- **Education / program information**
  - "Windows leak or sweat and the seal breaks. All of these can cause poor indoor air quality because of mold. Property managers need to be educated on how the windows can affect the livability of the unit for the tenants."
  - "Actively educate property manager of the programs available. Usually, they decide on a project that they think they need and later in the project they look around to see if there are any rebates; by then it's too late to take advantage of them. They should know the rebates before they plan the project."
  - "More information designed for property owners, equipment loans"
- **Application / program requirements**
  - "Easing the process and make finding rebate info easier"
  - "More streamlined process. Have consistent contact."
  - "I think condos would have the same problem as we did: figuring out if we qualified for the multifamily or the individual residential program. They should make it more clear for condos."

- **Rebate processing time**
  - "Fix the process delays. Having redundancies in the process. The contractor took photos and sent them in for the rebate. PSE decided they had to send their own inspector out to look, which added weeks to the timeline of getting rebates. Getting rebated in a timely manner is very important because of planning budgets."
  - "Get rebate in a timelier manner"

5.5 Barriers to Program Participation

Program participants were asked what concerns or barriers, if any, they had related to their participation in the program. As shown in Figure 5-6, over a third of respondents reported disruptions to tenants (21%) or hesitancy from tenants or other stakeholders (17%) as a barrier to program participation. Other commonly reported concerns or barriers surrounding the time commitment or how long the project took (17%), higher upfront cost or investment (16%), or program and eligibility requirements (12%).

Figure 5-6. Barriers to program participation



Note: Other barriers reported by property managers included contractor issues (3%), poor prior program experience (2%), and lack of interest (2%).

6 FINDINGS AND RECOMMENDATIONS

In this section, we summarize overall findings from the evaluation and recommendations based on these findings.

6.1 Key Findings

Key findings from the Multifamily Retrofit program impact and process evaluation are as follows:

FINDINGS

Overall Realization Rates: The program's overall realization rate was 88% for electric and gas savings combined. Electric savings accounted for nearly 90% of overall program savings. The realization rate for electric savings was 88%, and the realization rate for gas savings was 63%. This rate reflects the program's outcomes in terms of achieving its energy-saving targets, with varying results across different measures.

- **Electric Savings:** The program's evaluated electric savings were 9.9 million kWh, while the reported electric savings were 11.2 million kWh.
- **Gas Savings: The** program's evaluated gas savings were more than 29,700 therms compared to reported gas savings of over 46,900 therms.

Lower Realization Rate for Windows: The realization rate for Windows was 45%, indicating a variance between the reported and evaluated savings. The primary contributor to this lower realization rate for windows was an overestimation of windows savings in the RTF's deemed savings assumptions, although it is important to note that PSE did correctly use the RTF savings values for the window measures.

Data Limitations for Evaluating Smart Thermostats: The thermostat measure's savings were accepted as reported due to data limitations, including a lack of information on specific installation location and insufficient granularity on unit-level and common area consumption data. We also note that multiple studies have shown that the 5% savings rate assumption for smart thermostats is too high and should be reassessed.

Participant Satisfaction: Results from the property manager survey suggest the Multifamily Retrofit program is operating well and participants are, in general, highly satisfied with the program. Average satisfaction scores were high across all aspects of the program, ranging from 4.5 to 4.6 on a 5-point scale.

Program Outreach: Survey responses also suggest the program is doing a good job at educating contractors about the program and conducting direct outreach to property managers, which were key strategies noted during the program staff interview. Online survey results revealed that participants often found out about the program from PSE's marketing and communications (collectively 41%), including from the program website (15%), PSE's Energy Advisor (13%), or from a PSE phone call, direct mall, or email (13%). Almost a quarter (24%) found out about the program from their contractor.

Barriers to Program Participation: Property manager survey respondents cited disruptions to tenants (21%), hesitancy from tenants or other stakeholders (17%), and the time commitment or how long the project took (17%) as the primary barriers to program participation. Other commonly reported concerns or barriers included higher upfront cost or investment (16%) or program and eligibility requirements (12%).

6.2 Recommendations

Based on these key findings, DNV has the following recommendations:

Recommendations

Windows:

- **Addressing Low Realization Rate:** PSE should reassess the assumptions used for savings associated with windows. This should involve a closer examination of the building shell assumptions and actual usage patterns as well as a review of TRMs from other regions.
- **Collaboration with RTF Staff:** PSE should work with staff responsible for overseeing the RTF Windows savings assumptions (i.e., modelling approaches and assumptions) and encourage a deeper review in subsequent RTF workbook revisions.

Lighting:

- **Enhance Data Collection on Usage Hours:** PSE should systematically collect operational hours of use data for common area lighting from participating sites as part of the program, which could lead to additional savings. PSE should act soon on this recommendation because the window of opportunity for claiming lighting savings in multifamily buildings in Washington is likely to close within the next few years.

Thermostats:

- **Reconsideration of Measure:** Given that smart thermostats produced limited savings, PSE should reassess continued support for this measure as part of the Multifamily Retrofit program or include it with future demand response programs aimed at multifamily buildings.
- **Collaboration with RTF:** PSE should work with staff responsible for overseeing the RTF smart thermostat savings assumptions and encourage a deeper review in subsequent RTF workbook revisions. this effort could lead to a more accurate representation of the energy savings potential of thermostats, especially if the measure is continued or integrated into other programs, such as new demand response programs.

Barriers to Program Participation: PSE should consider developing a comprehensive communication plan to educate tenants about the benefits related to their participation in the program. This could include in-person presentations conducted in multifamily buildings with tenants to educate them on the energy and non-energy benefits (e.g., increase comfort) of energy efficiency upgrades.

7 APPENDICES

7.1 Appendix A: Sample Design

To create the sample frame for the Multifamily Retrofit survey effort, DNV used tracking data provided by PSE. We developed the sample design using a stratified random sample methodology to define recruitment targets for each measure grouping defined in the tracking data, oversampling sites with large overall savings claims to improve the precision of savings-weighted calculations. The sample was stratified based on combined equivalent MMBtu savings for each site rather than separately by gas or electric savings because of the large imbalance of fuel-specific savings (electric savings accounted for approximately 90% of program overall equivalent savings). The distribution of fuel-specific savings made it difficult to target a specific relative precision for each fuel-type without creating a sample of potentially hundreds of sites, which would not have been feasible to collect, and would have required unrealistic response rates for the gas-saving claims. The sample design, including population counts, target sample sizes, and expected relative precisions based on the design are shown below in Table 7-1.

Table 7-1. Multifamily Retrofit sample design

Measure Category	Number of Claims	Number of Sites (Population)	Target Sample	Expected Relative Precision
Windows	547	329	25	0.15
Thermostat	779	537	12	0.24
Lighting	262	149	12	0.22
Envelope	297	115	7	0.35
Other	444	196	4	0.48
Total	**2,329**	**1,326**	**60**	**0.10**

Following repeated outreach attempts to our sampled sites, we reached a total of 48 sites among our different measure categories. Table 7-2 below shows our achieved sample, as well as the resulting achieved relative precisions for each measure category.

Table 7-2. Multifamily Retrofit completed sample and achieved relative precision

Measure Category	Population	Achieved Sample	Achieved Relative Precision
Windows	329	23	0.07
Thermostat	537	12	0.00
Lighting	149	9	0.32
Envelope	115	3	0.25
Other	196	1	-
Total	**1,326**	**48**	**0.17**

7.2 Appendix B: Impact Evaluation Assumptions

The evaluation of window and envelope measures within the program is based on a set of assumptions that are crucial for understanding how the energy savings were modeled and evaluated. These assumptions encompass various factors such as the type of measures implemented, the characteristics of the buildings where they were installed, and the expected performance of these measures.

7.2.1 Window Measure Assumptions

Table 7-3 outlines the assumptions for various window measures. These measures range from the installation of double-pane to triple-pane windows, with specific focus on the thermal performance indicated by U-factor (U) and SHGC values. The assumptions are further detailed by number of floors and climate zone, reflecting the varying thermal needs and energy performance in different building configurations and climatic conditions.

Table 7-3. Window measure assumptions

Measure Name	Number of Floors	ASHRAE CZ	Baseline Assumption	Measure Assumption
Windows - Double Pane - from U60 to U30 - EH - MF	1	4B	U 0.8 SHGC 0.75	U-0.29 SHGC 0.75
Windows - Double Pane - from U60 to U30 - EH - MF	1	4C	U 0.8 SHGC 0.75	U-0.29 SHGC 0.75
Windows - Double Pane - from U60 to U30 - EH - MF	3	4B	U 0.8 SHGC 0.75	U-0.29 SHGC 0.75
Windows - Double Pane - from U60 to U30 - EH - MF	3	4C	U 0.8 SHGC 0.75	U-0.29 SHGC 0.75
Windows - Double Pane - from U60 to U30 - EH - MF - MI	4	4B	U 0.8 SHGC 0.75	U-0.29 SHGC 0.75
Windows - Double Pane - U30 - from SP U120 - EH - MF	1	4B	U 1.09 SHGC 0.75	U-0.29 SHGC 0.75
Windows - Double Pane - U30 - from SP U120 - EH - MF	1	4C	U 1.09 SHGC 0.75	U-0.29 SHGC 0.75
Windows - Double Pane - U30 - from SP U120 - EH - MF	3	4C	U 1.09 SHGC 0.75	U-0.29 SHGC 0.75
Windows - Double Pane - U30 - from SP U120 - GH - MF	3	4C	U 1.09 SHGC 0.75	U-0.29 SHGC 0.75
Windows - Triple Pane - U22 - from DP U60 - EH - MF	3	4C	U 0.8 SHGC 0.75	U-0.22 SHGC 0.75
Windows - Triple Pane - U22 - from SP U120 - EH - MF	1	4B	U 1.09 SHGC 0.75	U-0.22 SHGC 0.75

7.2.2 Envelope Measure Assumptions

Table 7-4 details the assumptions for envelope measures, particularly focusing on attic insulation upgrades. Similar to windows, number of floors and climate zone reflects the varying thermal needs and energy performance in different building configurations and climatic conditions and factors such as the existing insulation level (baseline assumption) and the upgraded insulation level (measure assumption) are detailed, alongside the building's HVAC system type.

Table 7-4. Envelope measure assumptions

Measure Name	Number of Floors	ASHRAE CZ	HVAC System	Baseline Assumption	Measure Assumption
Insulation - Attic - R11 to R49 - EH - MF	3	4B	Electric Furnace	roof base cont. insulation R11 (10.8)	roof base cont. insulation R49 (34.7)
MFRFT: Insulation - Attic - R11 to R38 - E	1	4B	Electric baseboard	roof base cont. insulation R11 (10.8)	roof base cont. insulation R38 (30.4)
Insulation - Attic - R0 to R49 - EH - MF	1	4C	Electric heater	roof base cont. insulation R8.5	roof base cont. insulation R49 (34.7)

7.3 Appendix C: Additional Survey Results

Below we provide additional demographic and general property-related results from the property manager surveys.

Figure 7-1. Role or title of respondent

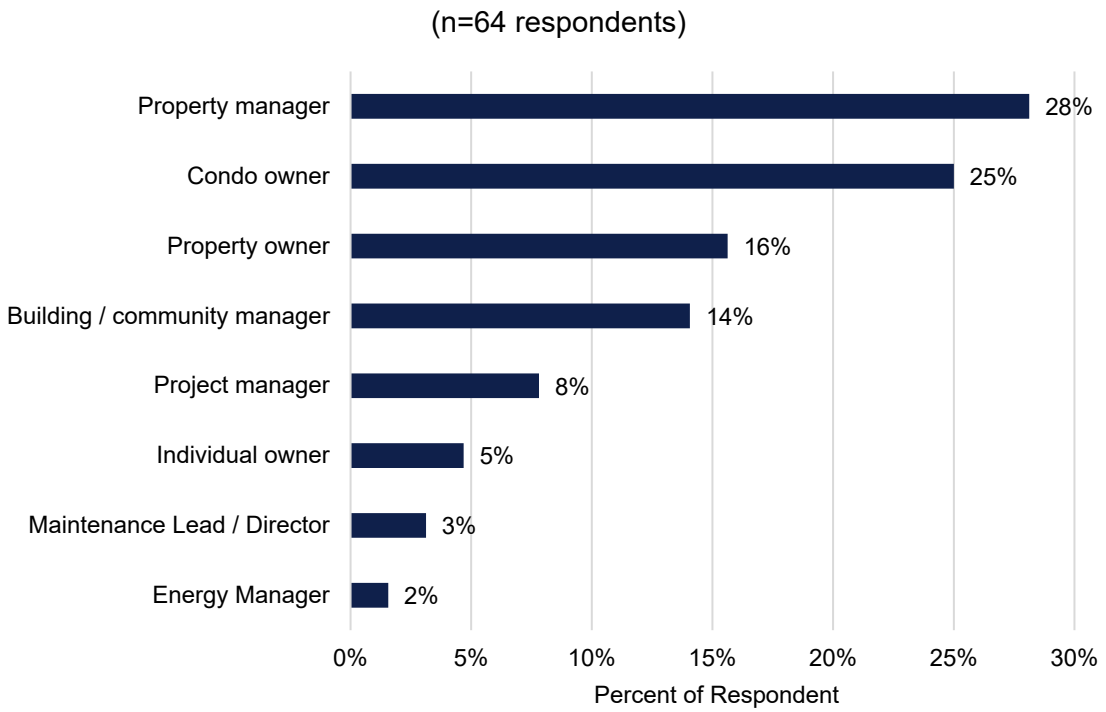


Figure 7-2. Average percent of units/tenants that are low-income

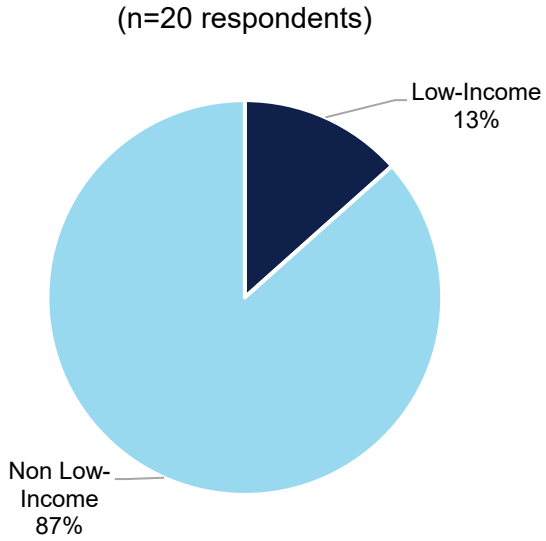


Figure 7-3. HVAC systems regular maintained (at least yearly)

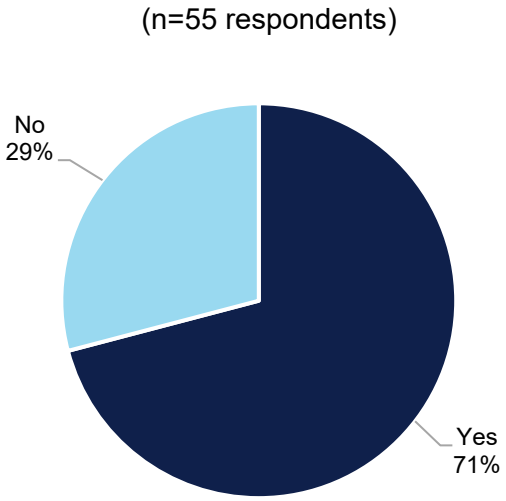
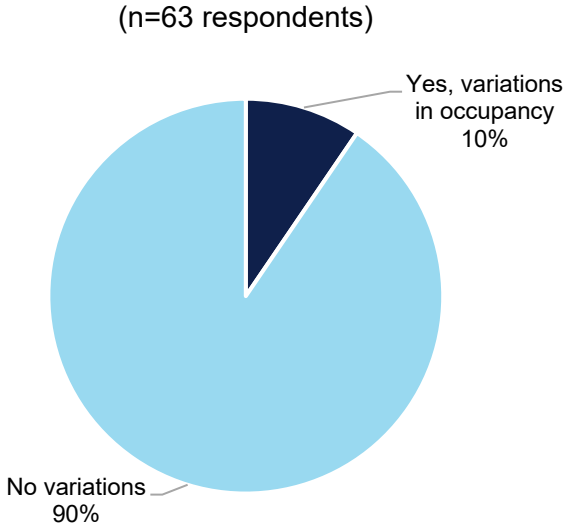


Figure 7-4. Seasonal variations in occupancy



7.4 Appendix D: Data Collection Instruments

To: Jesse Durst, Puget Sound Energy

From: Naveed Khan, David Avenick, Katie Ryder, Geoff Barker, DNV

Date: August 3, 2023

PSE: MULTIFAMILY RETROFIT PROPERTY MANAGER INTERVIEW GUIDE

1 INTERVIEW GUIDE OVERVIEW

Objective: DNV will administer in-depth interviews with property manager that participated in PSE's Multifamily Retrofit program to better understand building controls, occupancy, and their experience with the program to inform the process evaluation**.**

Anticipated timing (survey length): Approximately 20-30 minutes

Method of data collection: In-depth interview

2 SURVEY GUIDE

Table 1: Overview of Data Collection Approach

Data Collection	Description
Population Description	PSE Multifamily Rebate program participants – property managers
Instrument Type	In-depth interview
Survey/Interview Length	Approximately 20-30 minutes
Description of Contact Sought	Property managers who were involved in the Multifamily Rebate program

Email Invitation Template

[FROM]: **[RECRUITMENT EMAIL ADDRESS]**

[SUBJECT]: PSE Asks for your feedback on the Multifamily Rebate program

Hello **[Name]**,

Puget Sound Energy is committed to providing its customers with products and services designed to service customers like you. As part of this effort, we are conducting interviews with participants in PSE's Multifamily Rebate program. As a participant in PSE's programs, your opinions are important. Participation in this survey effort is voluntary. PSE would like your input and perspectives to understand how to best structure this program in the future for customers like you.

We'd like to schedule a time with you to discuss your participation in the program and gather your feedback. The meeting should take 20-30 minutes. Please indicate your availability during the following time slots. If none of these times work for you, please let me know and we can work with your schedule.

- Time 1
- Time 2
- ……

If you have any questions about this research effort, please contact the PSE Evaluation and Research Group at EESEvaluations@PSE.com.

Thank you for participating in PSE's program evaluation. We really appreciate your input!

[INSERT DNV Signature]

- This email was sent by DNV on behalf of Puget Sound Energy. DNV is an authorized agent of Puget Sound Energy. If you have questions about the survey or would like to be removed from future surveys, please contact the study coordinator at: survey.pse@impact.dnv.com.
- To unsubscribe from future energy efficiency promotional emails, contact eesevaluations@pse.com.
- Link to PSE's Privacy Policy: https://www.pse.com/pages/privacy
- PSE copyright: © 2023 Puget Sound Energy. All rights reserved.

2.1 Screener

Q1. According to our program files, you were involved in the decision making for the following upgrades to **[Address]: [LIST MEASURES FROM PROGRAM FILE].** Are you familiar with the upgrades to the property?
   a. Yes
   b. No
   c. Don't know

Q2. **[If Q1 = b or c]** Please provide the contact information of the person who would be familiar with these projects. **[RECORD CONTACT INFO] [THANK AND TERMINATE]**

Q3. **[If Q1 = a]** What is your role / title?
   a. Condo owner
   b. Property manager
   c. Property owner
   d. Individual owner
   e. Other

2.2 Verification

Q4. **[RECORD INFO FROM TRACKING DATA TO TABLES BELOW; INTERVIEWER TO CONFIRM IF BUILDING TYPE IS TOWNHOUSE/DUPLEX/ROWHOUSE, APARTMENT OR CONDO (2-4 units; 5 or more units] [Telephone survey only]** Our records show the following building type(s), number of units and year the building was built. Can you confirm this is accurate?

Building	Building type	Number of units	Year built	Internal Notes

Q5. **[RECORD INFO FROM TRACKING DATA TO TABLES BELOW] [Telephone survey only]** Our records show the following types of measures were installed at the site. Can you confirm this is accurate?

Building	Measure installed	Quantity	Savings type (kWh / therm)

2.3 General property/measure questions

Q6. **[Telephone survey only]** What is the total square footage of the building?
Please specify:

Q7. **[Telephone survey only]** How many floors does the building have?
Please specify:

Q8. **[IF NOT MENTIONED IN Q4] [Telephone survey only]** What year was the building constructed?
Please specify:

Q9. Are there any significant seasonal variations in occupancy?
a. Yes
b. No
Interviewer Notes:

Q10. **[Telephone survey only]** What type of heating and cooling systems are used in the building (central system, individual units, heat pumps)? How old are the systems?

Building	System type	Quantity (approx.)	Age of system(s)

Q11. Are the HVAC systems regularly maintained and serviced at least yearly?
a. Yes
b. No
c. Don't know
Interviewer Notes:

Q12. What types of thermostats do you have installed in your building?
a. Smart
b. Programmable
c. Manual
d. Other (please specify):
Interviewer Notes:

Q13. Approximately, what percentage of the common area lighting is on 24/7?
a. 0 - 20%
b. 20 - 40%
c. 40 - 60%
d. > 60%
e. Don't know

Q14. **[Telephone survey only]** Are there any known issues with the current insulation? **[PROBE IF NEEDED: gaps, moisture problems]**

Q15. What type of windows are installed in the building? **[RECORD]**
a. Single Pane
b. Double Pane
c. Low e
d. Other (please specify):
e. Don't know

2.4 Program outreach and participation

Q16. How did you first hear about this program? **[SELECT ONE - PROBE IF NEEDED]**
a. PSE Energy Advisor
b. Contractor
c. Phone call, direct mail or email from the program
d. Online or print media advertisement or promotion
e. Program representative knocked on my door
f. Door hanger left on the door
g. PSE website
h. Word of mouth (colleague, friend, or neighbor)
i. Previous program participation
j. Don't know
k. Other (please specify):

Q17. What challenges have you encountered in implementing energy-saving measures in your multifamily buildings? **[SELECT ALL THAT APPLY - PROBE IF NEEDED]**
a. Tenant comfort
b. Disruption to common areas
c. Issues with contractors
d. Cost of large capital projects
e. Getting projects approved by condo boards (where applicable)
f. Staff turn over
g. Not seeing the return on investment (ROI)
h. Supply chain issues
i. Getting tenants to agree
j. Don't know
k. Other (please specify):

Q18. What was the primary factor that influenced your decision to participate in this program? **[SELECT ONE - PROBE IF NEEDED]**
a. Corporate policy or guidelines or directive to participate
b. Utility rebates / incentives
c. Outreach from PSE or CLEAResult program staff
d. Availability of financing or co-payment
e. Equipment failure or end of useful life
f. Contractor recommendation
g. Colleague or friend recommendation
h. Reducing carbon emissions / good for the environment
i. Zero emission building
j. Tenant benefits / appeal to renters (improve occupant comfort, reduce energy bills)
k. Reduce operation and maintenance cost
l. Renovation / addition / remodel
m. Previous program participation
n. Don't know
o. Other (please specify):

Q19. What were the secondary factors which influenced your decision to participate in this program? **[SELECT ALL THAT APPLY - PROBE IF NEEDED]**

a. Corporate policy or guidelines or directive to participate
b. Utility rebates / incentives
c. Outreach from PSE or CLEAResult program staff
d. Availability of financing or co-payment
e. Equipment failure or end of useful life
f. Contractor recommendation
g. Colleague or friend recommendation
h. Reducing carbon emissions / good for the environment
i. Zero emission building
j. Tenant benefits / appeal to renters (improve occupant comfort, reduce energy bills)
k. Reduce operation and maintenance cost
l. Renovation / addition / remodel
m. Previous program participation
n. Don't know
o. Other (please specify):

Q20. How would you rate your overall experience with the program? Please use a 5-point scale where 1 = Very dissatisfied and 5 = Very satisfied.

a. 1 = Very dissatisfied
b. 2
c. 3
d. 4
e. 5 = Very satisfied
f. Don't know

Q21. How would you rate the equipment offerings with the program? Please use a 5-point scale where 1 = Very dissatisfied and 5 = Very satisfied.

a. 1 = Very dissatisfied
b. 2
c. 3
d. 4
e. 5 = Very satisfied
f. Don't know

Q22. How would you rate your experience with energy savings and cost reduction that resulted from the program? Please use a 5-point scale where 1 = Very dissatisfied and 5 = Very satisfied.

a. 1 = Very dissatisfied
b. 2
c. 3
d. 4
e. 5 = Very satisfied
f. Don't know

2.5 Program experience and satisfaction

Q23. Would you have installed the equipment with the same levels of efficiency without the incentives?

a. Yes
b. No

Interviewer Notes:

Q24. If **[If Q23= No]**, what would you have done? **[SELECT ONE]**

a. Install lower efficiency equipment
b. Would not have installed at all
c. Other (please specify):

Q25. When participating in PSE's program, what kind of information were you provided with? **[SELECT ALL THAT APPLY]**

a. Provided tips on how to save energy with the installed equipment
b. Provided tips on how to save energy unrelated to the installed equipment
c. Recommended participation in another energy conservation program
d. Provided additional energy savings opportunities during walk-through consultation
e. Provided information on financing options
f. Installers did not provide any information
g. Other (please specify):
h. Don't know [EXCLUSIVE]

Q26. What information from the installer or the program did you pass to tenants? **[SELECT ALL THAT APPLY]**

a. Tips on how to save energy with installed equipment
b. Tips on how to save energy unrelated to installed equipment
c. Recommendation to participate in other energy conservation program
d. I did not pass any information to tenants

Q27. When thinking about participation in this program, what concerns or barriers, if any, did you have prior to participation? **[SELECT ALL THAT APPLY]**

a. Added cost to install the recommended measures
b. Higher upfront investment – cash flow before the rebate comes in
c. Time commitment to interact with program (e.g., could have slowed down project)
d. Convincing other project decision-makers
e. Insufficient savings/payback not favorable
f. Lack of interest
g. Long duration
h. Disruption to tenant(s)
i. Labor issues (e.g., difficulty finding and coordinating staff to spearhead projects)
j. Length of time to complete retrofits
k. Tenant hesitancy about new equipment (e.g., unsure of reliability, lack of familiarity with new equipment)
l. Onerous program requirements
m. Poor prior program experience
n. Contractor issues
o. Tax benefits and financial arrangements for low-income multifamily housing
p. Eligibility limitations
q. Other (please specify):
r. None

Q28. Beyond program incentives, what do you think would encourage more property managers to participate in energy efficiency programs? [OPEN ENDED]

Q29. Is it ok if we follow up if we have any further questions?

a. Yes
b. No

Interviewer Notes:

About DNV

DNV is a global quality assurance and risk management company. Driven by our purpose of safeguarding life, property, and the environment, we enable our customers to advance the safety and sustainability of their business. We provide classification, technical assurance, software, and independent expert advisory services to the maritime, oil & gas, power, and renewables industries. We also provide certification, supply chain and data management services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping customers make the world safer, smarter, and greener.

PUGET SOUND ENERGY

Evaluation Report Response

Program: Multifamily Retrofit

Program Manager: McGregor Snow

Study Report Name: Multifamily Retrofit 2022-23 Impact and Process Evaluation Final Report

Draft Report Date: December 21, 2023

Evaluation Analyst: Jesse Durst

Date of Final Report Provided to Program Manager: February 5, 2024

Date of Program Manager Response: March 1, 2024

Overview

PSE's Multifamily Retrofit program (midstream and downstream) offers comprehensive retrofit and strategic energy management opportunities for residential building envelope, common areas, and in-unit dwellings. In order to qualify for the program customers must own or manage a multifamily dwelling or own a unit within a multifamily dwelling. Multifamily dwellings are defined as those with five or more attached units or those with less than five attached units but part of a campus.

Incentives are available for efficiency measures including weatherization, heating, ventilation, and air-conditioning (HVAC), controls, behavioral modifications, lighting, and appliances. The program aims to increase the installation of efficiency measures in existing multifamily buildings by working with property owners, managers, trade ally contractors, tenants, and multifamily campuses. The 2022 program emphasized the recruitment of low income and vulnerable populations. Direct install (DI) measures, audits, and marketing and outreach activities are implemented by a third-party contractor, while common area and building envelope measures are implemented by PSE's network of contractors.

Evaluation

The primary research objective of the program impact evaluation was to estimate the energy savings attributable to the program. To evaluate energy savings, the evaluation contractor gathered key information in telephone interviews with property managers, which included remote verification to confirm the installation of measures incentivized through the program. These interviews helped to characterize site-specific building usage, occupancy patterns, and occupant behavior, which are key components for evaluating energy savings of the program measures.

The primary research objectives of the process evaluation were to assess program awareness, participant satisfaction, and perceived barriers to program participation. The research activities included interviewing PSE program staff to better understand program challenges and opportunities and conducting an online survey with property managers or building staff familiar with the measures

installed in their buildings. The online survey focused on customer experience with the program, factors that may have influenced their participation and decision-making processes, and perceived barriers to program participation.

Key Findings

The key findings from the impact and process evaluations include:

- **Overall Realization Rates:** The program's overall realization rate was 88% for electric and gas savings combined. Electric savings accounted for nearly 90% of overall program savings. The realization rate for electric savings was 88%, and the realization rate for gas savings was 63%. This rate reflects the program's outcomes in terms of achieving its energy-saving targets, with varying results across different measures.
    - Electric Savings: The program's evaluated electric savings were 9.9 million kWh, while the reported electric savings were 11.2 million kWh.
    - Gas savings: The program's evaluated gas savings were more than 29,700 therms compared to reported gas savings of over 46,900 therms.
- **Lower Realization Rate for Windows:** The realization rate for Windows was 45%, indicating a variance between the reported and evaluated savings. The primary contributor to this lower realization rate for windows was an overestimation of windows savings in the RTF's deemed savings assumptions. While PSE correctly applied the RTF savings assumptions for Window measure, these savings assumptions are too high.
- **Data Limitations for Evaluating Smart Thermostats:** The thermostat measure's savings were accepted as reported due to data limitations, including inaccurate building address information for some projects and insufficient granularity for unit-level and common area consumption data, and challenges associated with conducting a billing consumption analysis for evaluating savings for smart thermostats in multifamily buildings. While the per unit electric savings claimed for smart thermostats in multifamily buildings is relatively small, multiple studies have shown small or no electric savings associated with smart thermostats. Thus, the assumed electric savings for this measure should be reassessed.
- **Participant Satisfaction:** Results from the property manager survey suggest the Multifamily Retrofit program is operating well and participants are, in general, highly satisfied with the program. Average satisfaction scores were high across all aspects of the program, ranging from 4.5 to 4.6 on a 5-point scale.
- **Program Outreach:** Survey responses also suggest the program is doing a good job at educating contractors about the program and conducting direct outreach to property managers, which were key strategies noted during the program staff interview. Online survey results revealed that participants often found out about the program from PSE's marketing and communications (collectively 41%), including from the program website (15%), PSE's Energy Advisor (13%), or from a PSE phone call, direct mail, or email (13%). Almost a quarter (24%) found out about the program from their contractor.

- **Barriers to Program Participation:** Property manager survey respondents cited disruptions to tenants (21%), hesitancy from tenants or other stakeholders (17%), and the time commitment or how long the project took (17%) as the primary barriers to program participation. Other commonly reported concerns or barriers included higher upfront cost or investment (16%) or program and eligibility requirements (12%).

Recommendations

Recommendation

Windows:

Addressing Low Realization Rate: PSE should reassess the assumptions used for savings associated with windows. This should involve a closer examination of the building shell assumptions and actual usage patterns as well as a review of technical reference manuals (TRMs) from other regions.

PSE Response

PSE will submit the results of the Multifamily Retrofit 2022-23 Impact and Process Evaluation to the RTF and encourage them to review the methods and assumptions factored into their savings analysis. Program staff will encourage the RTF to review available TRM's from other regions in light of the evaluation findings.

Collaboration with RTF Staff: PSE should work with staff responsible for overseeing the RTF Windows savings assumptions (i.e., modelling approaches and assumptions) and encourage a deeper review in subsequent RTF workbook revisions.

PSE Response

PSE will submit the results of the Multifamily Retrofit 2022-23 Impact and Process Evaluation to the RTF and encourage them to review the methods and assumptions factored into their savings analysis. Program staff will encourage the RTF to review available TRM's from other regions in light of the evaluation findings.

Recommendation

Lighting:

Enhance Data Collection on Usage Hours: PSE should systematically collect operational hours of use data for common area lighting from participating sites as part of the program, which could lead to additional savings. PSE should act soon on this recommendation because the window of opportunity for claiming lighting savings in multifamily buildings in Washington is likely to close within the next few years.

PSE Response

The 4ft T8 and T12 fluorescent lamp replacement measures referenced in the evaluation report assume 2,520 (28%) hours of use. Based on the recommendation, program staff will reevaluate the savings using higher HOU values consistent with high use areas in multifamily homes.

Recommendation

Thermostats:

Reconsideration of Measure: Given that smart thermostats produced limited savings, PSE should reassess continued support for this measure as part of the Multifamily Retrofit program or include it with future demand response programs aimed at multifamily buildings.

PSE Response

As long as the RTF continues to offer unit energy savings (UES) measures for smart thermostats and they remain cost effective, PSE will offer Smart Thermostats through our Multifamily Retrofit program. PSE also supports increasing opportunities for multifamily residents to participate in our current Demand Response program. Should the RTF no longer support smart thermostats as an effective energy conservation measure, PSE will consider transitioning the program to be solely a Demand Response program offering.

Collaboration with RTF: PSE should work with staff responsible for overseeing the RTF smart thermostat savings assumptions and encourage a deeper review in subsequent RTF workbook revisions. This effort could lead to a more accurate representation of the energy savings potential of thermostats, especially if the measure is continued or integrated into other programs, such as existing or new demand response programs.

PSE Response

PSE will submit the results of the Multifamily Retrofit 2022-23 Impact and Process Evaluation to the RTF and encourage them to revise review the Connected Thermostats and Residential Electric Line Voltage Thermostats workbooks.

Recommendation

Barriers to Program Participation: PSE should consider developing a comprehensive communication plan to educate tenants about the benefits related to their participation in the program, given the primary barriers to participation were disruption to tenants and hesitancy from tenants and other stakeholders. This could include in-person presentations conducted in multifamily buildings with tenants to educate them on the energy and non-energy benefits (e.g., increase comfort) of energy efficiency upgrades.

PSE Response

PSE's marketing and outreach teams regularly host education events and engage all PSE customer types including multifamily renters. Additionally, the Multifamily Retrofit program has held virtual engagement sessions called "Coffee and Conversation" that emphasize the many benefits of Energy Efficiency for health and safety. The program team will explore our leave-behind materials and a communication plan for distribution after efficiency project completion. The program team regularly discusses the benefits of Energy Efficiency with decision makers to encourage participation in Energy Efficiency. Property managers have occasionally been concerned about tenant disruption but typically those concerns have dealt with prioritizing health and safety retrofits before energy efficiency upgrades.