2012-2013 Multifamily Retrofit Program Impact and Process Evaluation Final Report

Contents:

- DNV GL Impact and Process Evaluation Report
- PSE Evaluation Report Response

This document contains the final DNV GL's Multifamily Retrofit Program Impact and Process Evaluation Final Report, and Puget Sound Energy's Evaluation Report Response (ERR). In accordance with WUTC conditions, all PSE energy efficiency programs are evaluated by an independent, third party evaluator.[1] Evaluations are planned, conducted and reported in a transparent manner, affording opportunities for Commission and stakeholder review through the Conservation Resource Advisory Group (CRAG) and reported to the UTC.[2] Evaluations are conducted using best-practice approaches and techniques.[3]

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

Please note that this is an evaluation of the program as it operated during the 2012 – 2013 program years, and does not necessarily reflect the program as currently implemented, or measures currently deployed by the program.

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

DNV·GL

2012-13 MULTIFAMILY RETROFIT PROGRAM

Impact and Process Evaluation Final Report

Puget Sound Energy

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1 EXECUTIVE SUMMARY

Puget Sound Energy (PSE) asked DNV GL to conduct a comprehensive process and impact evaluation of its Multifamily Retrofit Program for 2012-13 to verify measure installations, determine a program-level realization rate for energy savings, and provide recommendations aimed at improving program delivery. In addition to the process and impact evaluations, DNV GL is also conducting a forward looking market potential study to assess the 20-year energy efficiency potential in existing multifamily buildings.[4]

1.1 Program description

The PSE Multifamily Retrofit Program has been around since late 2006 and is designed to increase the installation of select cost-effective energy efficiency measures in existing multifamily buildings with five or more attached dwelling units. It provides free energy audits of multifamily buildings to help building owners, operators, and tenants better understand energy consumption and energy savings opportunities. Depending on the results of the energy audit, the program will directly install no-cost measures (e.g., showerheads) as well as provide incentives for more complex upgrades (e.g., windows).

1.2 Evaluation goals and approach

The study's goals were to verify measure installations, quantify program level energy savings, collect feedback from participants, and survey stalled participants, which are those who went no further in the program than just receiving the energy audit and direct-install (DI) measures. The study also sought to quantify the energy efficiency potential for existing multifamily buildings. DNV GL conducted the following tasks as part of the process and impact evaluations of the 2012-13 program:

- Reviewed program documents and database
- Onsite surveys
- Multifamily buildings energy consumption models
- Program savings realization rate
- Program staff interviews
- Logic model development
- Participant and stalled participant computer-assisted telephone interviews (CATI)

1.3 Impact evaluation results

The primary objective of the impact evaluation was to establish gross electric and natural gas energy savings realization rates for the 2012-13 program. DNV GL reviewed tracking data for all participants and collected site-level measure data for a statistically representative sample to analyze savings. The analysis yielded an electric gross-savings realization rate of 86% and a gas gross-savings realization rate of 77% (Table 1). The sampling precision of the evaluated (ex-post) savings estimate at 90% confidence is 15% for the electric savings and 22% for the gas savings[5]. Details of the methodology used to develop the ex-post savings are in section 2.3.

[4] DNV GL in partnership with Ecotope conducted market research and provided data and analysis necessary to estimate energy efficiency potential for existing multifamily buildings in PSE service territory.

[5] DNV GL estimated electric precision of 12% to 15% at 90% confidence and gas precision at 14% to 17% confidence at 90% in the sample design.

Table 1: 2012-13 program reported and evaluated energy savings

	Program Reported Savings[6]	Realization Rate	Evaluated Savings	Precision at 90% Confidence	Evaluated Savings Range at 90% Confidence		Evaluated Savings Range (%) at 90% Confidence	
					Low	High	Low	High
Electric (kWh)	44,208,769	86%	37,900,908	15%	32,215,772	43,586,044	73%	99%
Gas (therms)	155,082	77%	118,664	22%	92,558	144,770	60%	93%

DNV GL determined the program realization rates by completing site level measurement and verification on a sample of 62 program participants selected using a stratified random sampling approach. The stratum was based on site-level energy savings, with each strata containing sites with similar levels of savings. Each site-level analysis included an on-site audit to verify measure installation and any collect data necessary to build energy consumption models for buildings that made shell (e.g., window, insulation) and/or HVAC improvements. DNV GL used the data collected and calibrated models developed to calculate ex-post site level energy savings and the site level realization rates. Program level ex-post savings and realization rates were determined by extrapolating the sample results back to the program population.

In addition to the realization rates calculated, this impact evaluation yielded two key findings. First, the persistence of DI and leave-behind measures was lower than assumed by the program. For example, approximately two-thirds of installed lighting, which consisted of compact fluorescent lamps (CFLs) and light-emitting diodes (LEDs), remained in place two to three years after installation. This is much lower than the assumed measure life of each. Second, power strips (the program's only leave-behind measure) were found to have the lowest installation rate of any measure at 13%.

1.4 Process evaluation findings

This section provides the key process evaluation findings.

1.4.1 How stalled participants differ from full participants

One of the key research questions for this process evaluation is why certain program participants, defined as any multifamily site that had a measure installed through the program, went no further in the program than just receiving the energy audit and the DI measures (i.e. a stalled participant). The surveys for full participants and stalled participants asked some of the same questions and comparing those responses can help the program better understand why some participants went further than others.

The next two tables show the survey topics for which there were statistically significant differences between full and stalled participants. For each of these topics we not only present the differences in survey response frequencies but also provide some explanation on why these differences might exist or what their implications might be. Differences in firmographics, such as the size of a building or how many properties a manager has, and property characteristics are provided in Table 2.

[6] Reported to DNV GL by Puget Sound Energy

Table 2: Statistically significant differences between firmographics and property characteristics of full participants vs. stalled participants

Survey Topics	Explanations and Implications
Working onsite: Stalled participants were more likely (89% of respondents) than full participants (72%) to say they worked onsite at the property.	This is likely explained by the full participant sample having condominium owners (14% of sample) and the stalled participant sample having none.
Older properties: Stalled participants reported a significantly higher proportion of properties built prior to 1940 (12% of respondents) compared with full participants (4%).	• For some older properties the barrier of the cost to come up to code could be too high, or that the technology may not be compatible with older plumbing. • Older properties have higher general maintenance costs and therefore maintenance projects may be absorbing capital funds that might otherwise go to energy efficiency projects.
Tenant incomes: • Full participants were much more likely than stalled participants to report having mostly high-income tenants (11% vs. 1%). • Stalled participants were more likely (23% of respondents) than full participants (11%) to characterize their tenants as "somewhat diverse with both low- and middle-income tenants."	• Having top-line energy efficient equipment could be a selling point for higher-income apartments when competing with other similar apartment buildings. • Green living environments can be a selling point for high-income apartment buildings and condominiums. • In contrast, in multifamily buildings with lower-income tenants, there is a lower likelihood of tenants moving out to get newer or better amenities due to the cost of moving.

Table 3 provides statistically significant differences in program participation and satisfaction of full vs. stalled participants.

Table 3: Statistically significant differences in program participation and satisfaction of full participants vs. stalled participants

Survey Topics	Explanations and Implications
Recall of energy efficiency (EE) suggestions from the energy audit: Full participants had a significantly higher recall of receiving suggestions for energy efficiency improvements (49% of respondents) than stalled participants (24%).	• The stalled participants had received the audits further in the past (2010-13) than the full participants (2014) and therefore were less likely to remember them. • The stalled participants might have received fewer audit recommendations than the full participants and therefore had less reason to participate in the full program. • Since the full participants implemented some of the measures recommended in the audit, they were more likely than the stalled participants to remember these recommendations.
Recall of EE incentives: Full participants had a significantly higher recall of receiving PSE rebates for implementing audit-recommended EE projects (50% of respondents) than stalled participants (29%).	• We would have expected the difference in the response rates of these two groups to be actually much larger. • It is surprising that only half of the full participants recalled receiving the program incentives. One possible explanation is that some of full participants were unaware of the rebate because their contractors took the rebates and gave them line-item discounts instead, which is allowable under the current program. For larger property management companies it is also possible that program rebate checks went to a corporate accounting department rather than to the onsite survey respondent. • The 29% of stalled participants who said they received a PSE rebate is also an unexpected result. Possible explanations for this include: ○ Some stalled participants may have actually been full participants who were misclassified due to difficulty of matching records from different tracking databases or because much time had passed between the program energy audit and the implementation of the energy efficiency project. ○ Some stalled participants may have considered the DI measures as rebated measures. ○ Some stalled participants may have installed program-rebate-eligible measures that were not recommended by the audit. ○ Some stalled participants may have mistaken vendor rebates for PSE rebates.
Recall of program contractor assistance: A significantly higher proportion of the full participants (44% of respondents) reported they received assistance in finding contractors to install energy-efficient measures than did the stalled participants (17%).	Possible explanations for this difference include: • Full participants were more likely to reach out for contractor assistance because they had decided to implement the recommended measures. • A lack of program assistance in finding a contractor contributed to stalled participants not installing any measures. • The stalled participants did receive program assistance with contractors but they said they did not because they had simply forgotten about it or because the person who had received the assistance was no longer there. These issues of forgetfulness and employee churn are likely to be greater for the stalled participants because their interaction with the program was further back in time.

Survey Topics	Explanations and Implications
Installing recommended measures without program rebates: The stalled participants who recalled the recommended measures were significantly more likely to have said they installed measures, but did not apply for a rebate than the full participants (61% vs. 16%).	• This higher percentage of stalled participants is what we would expect since, by definition, stalled participants are those who did not seek rebates for audit-recommended measures. • The stalled participant responses should be considered a form of participant spillover. This is because the program audit influenced their decision to install these measures, but since the stalled participants did not apply for program rebates, the program never claimed the energy savings from these measures.
Satisfaction with the overall program: Participants had a higher level of satisfaction (mean of 4.59 on a five-point scale) compared with stalled participants (mean of 4.30).	• This may be due to full participants receiving more benefits from the program than the stalled participants. • Yet it is also possible that dissatisfaction with the program caused some stalled participants to not progress any further.

1.4.2 Program successes and challenges identified from stalled participant survey

There was evidence of participant spillover energy savings. Eighteen percent of the stalled participants said they had implemented energy-efficient improvements which their program energy audit had recommended. These improvements occurred outside of the program and therefore were not captured by the PSE tracking system. The measures included CFL fixtures, LED fixtures, in-unit refrigerators, in-unit clothes washers, windows and sliding glass doors, and in-unit water heaters.

There is evidence that the program's LED offerings may be attractive to stalled participants. When we asked the stalled participants about their suggestions for improving the program, one of the most common suggestions were to use better quality light bulbs. In the program period when these customers were participating (2010-13) the program was direct installing CFLs, which many end users view as a lower quality product than LEDs. Now that the 2015 program is offering LEDs, these bulbs might attract some of the stalled participants back into the program.

The program's incentive structure seems aligned with customer preferences. Thirty-three percent of the stalled participants who recalled the audit recommendations said they would need financial support to implement the recommended measures. When asked what type of financial support would help, they all preferred incentives and rebates over low-interest loans.

Some stalled participants were unhappy with the quality of the installed equipment. Over half of the stalled participants who were less than satisfied with the program overall were not pleased with the performance of the equipment they received[7]. We have found this same correlation between dissatisfaction with the equipment and dissatisfaction with the program as a whole in other multifamily programs we have evaluated. As noted, the program's recent shift from CFL to LEDs could help allay some of these quality concerns since some people dislike the performance of CFLs.

Additional findings that led to direct program recommendations are presented in Section 1.6.

[7] The most common, specific feedback about poor equipment performance that DNV GL received from both full participants and stalled participants during the on-site audits and surveys was related CFLs and refrigerators.

1.4.3 Program successes identified from full participant survey

Levels of program satisfaction were consistently high. The average satisfaction ratings of full participants were consistently high, as Figure 1 shows. Ninety percent of respondents gave satisfaction ratings of 4 or 5 on the five-point scale.

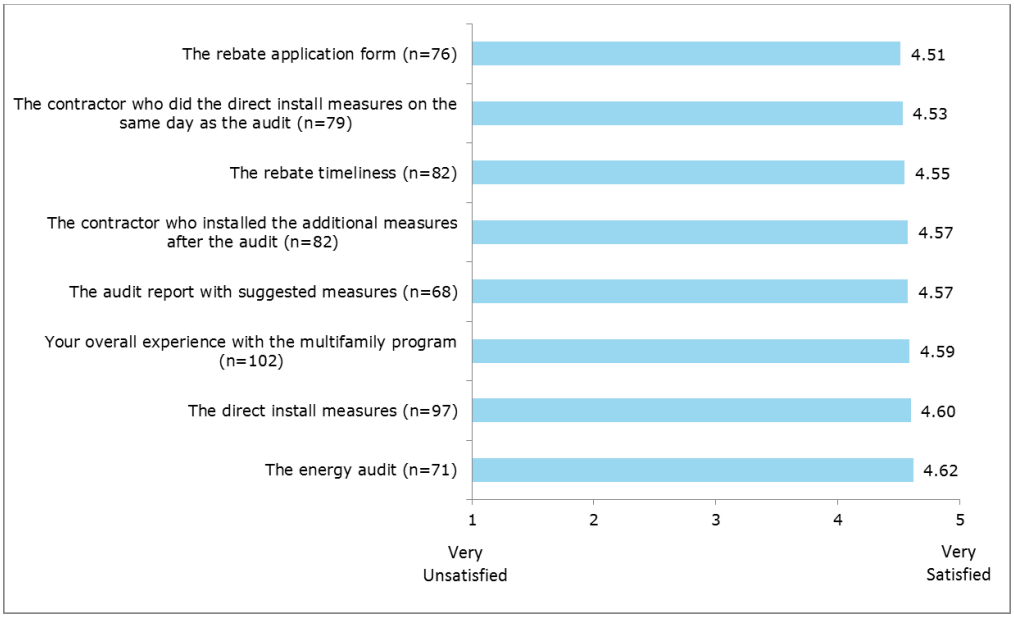

Figure 1: Average program satisfaction levels

Program outreach efforts that are more personal seem to be successful. When we asked the full participants how they first became aware of the program, four of the top five ways they cited were related to personal contact. These included word of mouth, a colleague recommending it, a contractor contacting the participant, and PSE visiting/calling about the program. This shows the importance of personal contact in driving participation in this program.

The program audits are helping customers identify new EE opportunities. Sixty-one percent of the full participants said that the program had helped them identify energy efficiency opportunities which they were previously unaware of. Those who indicated high levels of satisfaction with all aspects of the program were significantly more likely to have said the program helped them identify new energy efficiency opportunities (81%) than those who were less than satisfied with at least one aspect of the program (51%). This suggests that audits are an important component of the program.

PSE's Contractor Alliance Network has been successful in helping provide participants with contractors. Over half of respondents (58%) reported they heard about their contractor through PSE's contractor alliance network. The next highest response (16%) was from a contractor they had used before. This demonstrates the usefulness of the Contractor Alliance Network for helping respondents find contractors.

There is participant spillover. Sixteen percent of the full participants reported that they had installed energy efficient equipment that had been recommended by the program audit but they had not applied for a program rebate for these measures.

Plans for installing other program-recommended measures. Seventeen percent of the full participants said they had plans to install additional audit recommendations but they had not gotten to these yet. The measures which they most frequently reported as planned but not yet installed included insulation, LED fixtures, and common area lighting.

1.4.4 Program challenges and opportunities from full participant survey

While satisfaction levels with the program were very high overall, there were some full participants who were dissatisfied. Table 4 lists the levels of participant dissatisfaction for each program attribute and the reasons for their dissatisfaction.

Table 4: Full participants: Program dissatisfaction levels and reasons

Attribute of Program	% Less Than Satisfied	Reasons for Dissatisfaction
Audit, Audit Report	6%	• They did not get any new suggestions. • The report did not have the measures the respondent wanted. • The report did not have enough information on next steps. • The report was not received.
Direct Install Measures	11%	• The installed equipment was low quality/broke. • The installation took too long.
Direct Install Contractors	10%	• The contractor was unprofessional. • The contractor was messy or broke something. • The contractor showed up late.
Contractors Installing Program-Rebated Measures	8%	• The contractor was unprofessional. • The contractor was messy or broke something. • The contractor showed up late.
Rebate Application Forms	7%	The rebate form was difficult to complete.
Rebate Timeliness	8%	• The rebate took too long. • The rebate was never received.

1.4.5 Evidence of program attribution

We asked the full participants a number of questions to better understand the influence of the program over their decision to install the energy-efficiency measures. The following are some of the key findings concerning program attribution:

- *The origin of the project idea:* We asked the full participants who came up with the idea for the energy efficiency improvements at their property. Over half of respondents (54%) indicated that the idea to do energy efficiency improvements on their property came from the organization's internal management team. In 21% of responses, the idea for energy efficiency was due to the program, either coming directly from the contractor, or from the program energy audit. In 14% of cases, the respondents equally credited their organization and PSE and/or the contractor for coming up with the idea.
- *Identifying new EE opportunities:* Sixty-one percent of respondents indicated that the program had helped them identify energy efficiency opportunities which they had been previously unaware of.
- *The energy audit:* The survey asked respondents how likely they would have been to get an energy audit without the PSE program. Sixty-three percent of respondents indicated that without the PSE program, they still would have been very likely or likely to get an energy audit.
- *Contractor assistance:* As noted, over half of respondents (58%) reported they heard about their contractor through PSE's Contractor Alliance Network.
- *Participant spillover:* As noted, sixteen percent of the full participants reported that they had installed energy efficient equipment that had been recommended by the program audit but they had not applied for a program rebate for these measures.
- *The installation of the EE measures:* The survey asked the full participants the likelihood of installing each of the rebated measures both without the energy audit and then without the program. As shown in Figure 2, the frequency of responses did not shift much when asked about the likelihood of installing the rebated measures without the program as opposed to without the energy audit.

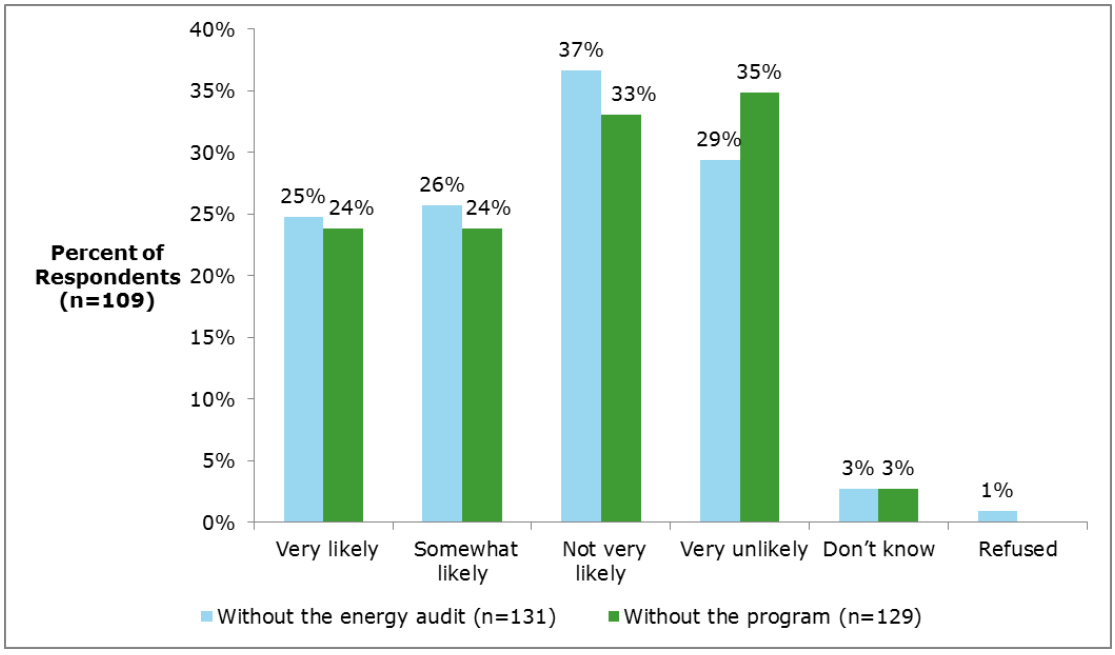

Figure 2: Likelihood of installing EE measures

1.5 Recommendations

Based on the key findings, recommendations collected directly from program participants and stalled participants, and DNV GL's overall assessment of the program, we offer the following recommendations:

Impact Evaluation Recommendations

Direct installation measures do not have 100% persistence. For planning purposes, including cost-effectiveness analysis, the program should assume that a portion of measures directly installed by the program either fail or are removed by tenants before the end of their useful lives.[8]

Assume an appropriate attrition rate for "plug" measures such as power strips. Appliance and water fixture measures generally are left in place in tenant units, while measures that are plugged in can be easily removed by the property owner or tenant. The program may be able to use follow-up communications to address the issue where measures were left to the property manager and were never installed.

Combine program tracking database and project file data. The program tracking data from the 2012-13 program was done at the site level while the project details, including where (i.e. tenant units) the measures are installed, are kept in separate disconnected files. Expanding the tracking database to include all of the relevant project level info would provide additional sample points for evaluations, allow for more reporting options, and ultimately help PSE better understand their program. Upon receipt of the draft report, PSE informed DNV GL that this issue is being addressed with the implementation of energyOrbit™ operations platform.

Process Evaluation Recommendations

The top suggestions which the full participants had for improving the program included expanding the program to cover more equipment or property types (7%), simplifying the rebate process (7%), providing more program information (6%) and using better quality products (5%). There were several key process findings from the stalled participants that led to the following recommendations for program improvement:

The stalled participants have positive attitudes towards energy efficiency. The survey revealed that a large majority of the stalled participants thought that energy efficiency was important. This should allow the program to focus more on overcoming financial and other non-behavioral barriers to energy efficiency implementation.

The split-incentive barriers may not be as significant as they seem. Over half (60%) of the stalled participants reported that their decision making process for tenant areas and common areas was the same. The reduced importance of the split-incentive barrier among this stalled participant group should make it easier for the program to encourage action.

There may be opportunities to work with appliance supply contractors. Over a third (36%) of the stalled participants said they did have a contractor they used more frequently and nearly half (48%) of these mentioned HD Supply as their frequent contractor. When we asked the respondents what services they used these specific contractors for, they most frequently reported using them to get appliances (44%) and maintenance supplies (40%). So if the program is not already working with HD Supply and other similar

[8] While the estimated mechanical life of an advanced power strip is ten years, the RTF assumes a measure life of five years, half the mechanical life, to account for removals. The five year measure life is based on professional judgment as there are no known persistence studies.

contractors, these survey results indicate that there is a real opportunity there for measures such as refrigerators.

There is need for more participant education on available rebates and other assistance. There was evidence from the stalled participant survey that more program information and assistance could have helped them move beyond the audit to project implementation. As noted above, 18% of the stalled participants said that they installed measures recommended by the program audit without seeking a rebate for these measures. When we asked them why they did not seek a rebate from PSE, their responses included not knowing about the rebates and believing they were ineligible for them. These responses indicate that the program could be doing more customer education in terms of drawing a stronger link between the audit recommendations and the program's rebate offerings.

Twenty-two percent of those stalled participants who recalled audit recommendations said additional information could have helped them implement some measures. The helpful information they mentioned included having someone come to give a bid for the work, getting back in touch with the implementers, a more detailed breakdown of what is available and the type of resources available to get it, and to receive more information on the measures.

The large majority of the stalled participant respondents only had very limited authority for project approval. Seventy-four percent of the stalled participant respondents said that they needed additional authorization over a certain dollar limit. Of those who needed additional authorization, the mean dollar amount they had authorization up to was $1,046 and the median was $500. This indicates that while the respondents were people involved in the program, they did not have sole authority to decide what equipment to install and how much of it to install. The authority generally rested with the owner (33%) or the regional manager (29%). This means that persuading the onsite manager may not be enough to get an energy efficiency project to move forward.

Many recent participants are not recalling the program rebates, which could negatively impact program attribution. Forty percent of the full participants said they did not receive a rebate or incentive. This is surprising because their participation was relatively recent and so one would not expect many to have forgotten about the measures. This low level of full participant recall should be a concern for the program since it will reduce levels of program attribution (e.g., increase free ridership). It is possible that some of these full participants were unaware of the rebate because their contractors took the rebates and gave them line-item discounts instead, which is allowable under the current program. However, it is surprising that the contractors would receive the rebates this frequently. And even in these cases, one would assume that the contractors would still mention the discount as being program-influenced.

Email is the preferred means for providing program information. The survey asked the full participants about their preferred method of contact if PSE were to provide them with more information about rebates and other program services. The large majority (71%) of respondents cited email as their most preferred method of contact. The second and third most-cited preferences were in the mail, separate from the bill (28%) and as a bill insert (15%). It is not clear how frequently the program currently uses email to communicate program information but these findings indicate that there are opportunities to do more of these types of communications.

2 IMPACT EVALUATION

The following sections discuss the impact evaluation methodology employed by DNV GL as well as the key results of the study.

2.1 Impact evaluation overview and objectives

The objective of this impact evaluation was to establish a realization rate for the program's gross electric and natural gas energy savings. The program largely relied on RTF deemed savings estimates as well as PSE deemed estimates and custom calculations (i.e. for common area lighting projects) for its energy savings claims. Energy savings were achieved by the program through the installation of multiple measures at multifamily facilities. These measures ranged from DI measures such as light bulbs, shower heads, refrigerators, clothes washers, and leave-behind power strips, to weatherization measures such as attic insulation, basement insulation, air sealing. Some facilities achieved further natural gas savings by replacing their boiler through the program.

DNV GL achieved the study's objective by completing site level measurement and verification (M&V) on a sample of program participants. The participant sample was designed to achieve the most precise program level realization rates possible given the financial constraints of the project and assumptions regarding the expected variance in the sample results. Sampling ignored fuel type by converting all savings to thermal units saved in British thermal units (BTU). As a result, the sample design reduced the expected error by focusing on participant sites with the highest overall BTU site savings. The final sample included 62 projects that fell into the categories outlined in Table 5. DNV GL performed on-site audits at all 62 sites.

Table 5: Number of sites in sample by fuel type and analysis type

Measure Type	Electric	Gas	Both Fuels	All Fuel types
Direct Install Only	34	6	1	**41**
Weatherization Only	10	4	0	**14**
Weatherization, Leave-Behind and Direct Install	5	0	2	**7**
All Analysis Types	**49**	**10**	**3**	**62**

Approximately two-thirds (41 out of 62) of sampled sites were "direct install only" sites. DNV GL concentrated on verifying installed measures claimed by the program at these sites. The remaining 21 sites in the sample had weatherization measure which required additional data collection and energy consumption modeling. A detailed explanation of the different analysis approaches for each measure category is described in Section 2.5. The following sections discuss the methodology and assumptions used in the sample design.

2.2 Sampling

This section presents DNV GL's sample design for the impact evaluation of PSE's 2012-13 Multifamily Program.

2.2.1 Background

The objective of the sample design was to support estimates of installation rates and program savings for the program with the highest level of precision while considering the original project goal of 50 on-site audits.[9] Model-based statistical sampling techniques were used to determine the program participant sample for the program using site-level energy savings estimates from PSE's 2012-13 program tracking data. Since the primary goal of the sample design was to verify program level savings for the entire program, the sample was not stratified by building or measure type.

The impact sampling methodology followed the following distinct steps:

- Reviewed program tracking records and use project level (i.e. site address) ex-ante energy savings estimates to create one site level sampling population combining the 2012 and 2013 program populations
- Combined electric and gas energy savings into BTU savings to create a fuel neutral population
- Used model-based statistical sampling techniques to optimize and select the actual sample for on-site audits
- Contacted selected building owner participants to schedule on-site visits, deferring to backup sites only when sites selected for the primary sample declined to participate in the evaluation or could not be reached after reasonable effort.

Because sample precision is driven by variability, the sample size was developed based on the expected variability in actual savings as determined by the error ratio. The error ratio is a summary statistic of variability of the ratio of verified to tracking system energy savings. Based on experience with similar studies, we anticipate an error ratio between 0.5 and 0.6. Mathematically, the error ratio is the standard deviation of the realization rate divided by the mean realization rate. For a sample, the error ratio can be expressed as:

$$er = \frac{\sqrt{\sum_{i=1}^{n} w_i \left(e_i^2 \Big/ x_i^{\gamma} \right) \sum_{i=1}^{n} w_i x_i^{\gamma}}}{\sum_{i=1}^{n} w_i y_i}$$

Where,

n is the sample size

w_i is the population expansion weight associated with each sample point i

x_i is the program reported savings for each sample point i

y_i is the evaluated gross savings for each sample point i

γ (gamma) is a constant with a value of 0.8

[9] The sample was increased to 58, adding 8 gas sites, to improve the precision of gas savings estimates.

$e_i = y_i - bx_i$ is an error for each sample point where b is the program realization rate

$$b = \frac{\sum w_i \, y_i}{\sum w_i \, x_i}$$

DNV GL used the sample planning tool previously developed for PSE under a separate project to optimize the sample and select sites. Again, the impact sample is drawn from 2012 and 2013 program tracking data provided by PSE.

2.2.2 Participant data and aggregation

The participant data files provided by PSE included energy efficiency measures completed during the 2012 and 2013 program years. There were 56 gas measures and 1,040 electric measures in 2012. Similarly, there were 123 gas measures and 1,488 electric measures in 2013. There were multiple measures associated with an individual site, so we began by aggregating energy savings by site based on site addresses. In doing so, we noticed that some sites had measures in both program years and some sites had both electric and gas measures. Counts and ratios of participant sites across program year and fuel type are shown below in Table 6. The sites in the '2012 and 2013' category tend to be large projects where project implementation spanned both years.

Table 6: Counts and ratios of sites by year and fuel type

Year	Fuel	# of Sites	% of Total
2012	Gas	44	5%
	Electric	364	95%
	Gas and Electric	2	0%
	Total	**410**	**100%**
2013	Gas	108	3%
	Electric	414	94%
	Gas and Electric	11	2%
	Total	**533**	**100%**
2012 and 2013	Gas	0	0%
	Electric	90	91%
	Gas and Electric	2	9%
	Total	**92**	**100%**

DNV GL converted the kWh and therm savings into source BTU to create one sampling variable. Table 7 provides the percent of source BTU savings by program year group.

Table 7: Source BTU savings by program year

Year	# of Sites	% of Total	BTU Savings	% of Total
2012	410	40%	178,777,164,747	38%
2013	533	51%	179,075,708,241	38%
2012 and 2013	92	9%	110,560,205,068	24%
Total	**1035**	**100%**	**468,413,078,056**	**100%**

Table 8 shows the total and percent BTU savings by fuel type.

Table 8: Count of sites by fuel, total BTU, and percentage of total

Fuel	# of Sites	% of Total	BTU Savings	% of Total
Gas	152	15%	14,258,064,393	3%
Electric	868	84%	439,962,508,326	94%
Gas and Electric	15	1%	14,192,505,337	3%
Total	**1035**	**100%**	**468,413,078,056**	**100%**

The breakout of the gas plus electric savings in Table 8 is given in Table 9.

Table 9: Count of sites by fuel, total BTU, and percentage of total

	Gas BTU	% of Total	Electric BTU	% of Total	Total BTU	% of Total
Gas and Electric	1,634,053,258	12%	12,558,452,079	88%	14,192,505,337	100%

As shown in the tables above, gas-only sites contributed just over 3% of total BTU savings, which supported the decision to proceed with a sample design prioritized by total BTU savings and stratified by program year only (i.e., not fuel type) which improves the chance of selection of sites with the greatest energy savings. Originally, DNV GL proposed for gas sites to be represented within the sample at the percent that they exist within the program tracking data. As a result of this low percentage, DNV GL projected a low precision for gas savings. DNV GL considered this acceptable given the sample design objective of verifying total 2012-13 program savings with the highest precision while adhering to the project scope of 50 on-site audits. Upon further consideration, PSE directed DNV GL to add an additional 8 gas sites (bringing the total number of on-

site audits to 58) to improve the relative precision (at 90% confidence) of gas savings. The final sample design includes stratification by both program year and fuel type savings, with a disproportionate number of gas sites (compared to percentage of total BTU savings). DNV GL ended up completing 4 extra sites in order to fulfill specific strata quotas, bringing the total number of audited sites to 62. The distribution of completed sites by measure type and fuel type is shown in Table 10.

Table 10: Number of sites in sample by fuel type and analysis type

Measure Type	Electric	Gas	Both Fuels	All Fuel types
Direct Install Only	34	6	1	**41**
Weatherization Only	10	4	0	**14**
Weatherization, Leave-Behind and Direct Install	5	0	2	**7**
All Analysis Types	**49**	**10**	**3**	**62**

2.2.3 Sample design

The sampling methodology employed a stratified ratio estimation model that first placed participants into segments of interest (program year category) and then into strata by size, measured in BTU savings. The model then estimated appropriate sample sizes based on the expected variance (estimated based on results of other similar evaluation studies) of the verified BTU savings to the tracking BTU savings (the error ratio). We looked at two precision estimates when developing the sample design.

- For the first estimate, we assumed an error ratio of 0.5, which we believe strikes a balance between previous experience with multifamily retrofit evaluation work we have done and the nature of participants of interest to this study. Using this error ratio, we estimated the relative precisions on the verified-to-gross ratio, labelled "Expected Relative Precision" in Table 11.
- For the second estimate, we assumed a "worst case" error ratio of 0.6, labelled "Conservative Relative Precision." Using this error ratio, we estimated the relative precision on the verified-to-gross ratio if the variance in observations is a little larger than what is expected.

As previously mentioned, the project originally established a target to complete 50 on-site audits and DNV GL optimized the sample design around that target. However, after assessing the relative precision of gas savings (25%-30% at the 90% confidence interval) under the original sample design, PSE opted to add an additional 8 gas sites to improve the relative precision. The additional gas sites were selected in a similar fashion as the original sample, with the largest savings sites getting top priority to create the highest level of precision for overall gas savings within the program.

Table 11 shows DNV GL's planned estimates of precision on the final sample design for the entire two-year program sample by program year category. The relative precision for the overall program was estimated at +/-11% at the 90% confidence interval for the expected scenario and +/-14% at the 90% confidence interval under the conservative scenario.

Table 11: Planned Precision estimates by program year

Program Year Category	Sample Sites	Population Sites	Expected Relative Precision at 90% Confidence	Conservative Relative Precision at 90% Confidence	Percent Program Savings (BTU)
2012	22	410	19%	23%	38%
2013	23	533	19%	22%	38%
2012 and 2013	13	92	21%	26%	24%
Overall	**58**	**1035**	**11%**	**14%**	**100%**

Table 12 shows DNV GL's planned estimates of precision of the final sample design by fuel saving type (i.e. electric and gas).

Table 12: Planned Precision estimates by fuel type savings

Fuel Saving Type	Sample Sites	Population Sites	Expected Relative Precision at 90% Confidence	Conservative Relative Precision at 90% Confidence	Percent Program Savings (BTU)
Electric	46	868	12%	15%	94%
Gas	8	152	24%	29%	3%
Electric and Gas	4	15	14%	17%	3%
Overall	**58**	**1035**	**11%**	**14%**	**100%**

Table 13 shows the same planned sample as Table 12, but allocated the electric plus gas savings to their respective fuel type savings category. The planned estimated relative precision for electric savings was +/-12% at the 90% confidence interval for the expected scenario and +/-15% at the 90% confidence interval under the conservative scenario, while the planned relative precision for gas savings was +/-14% at the 90% confidence interval for the expected scenario and +/-17% at the 90% confidence interval under the conservative scenario. Achieving 10% precision would require a significantly larger sample size, and a significant impact on the evaluation budget, without a significant improvement in precision.

Table 13: Planned Precision estimates by fuel type savings

Fuel Saving Type	Sample Sites	Population Sites	Expected Relative Precision at 90% Confidence	Conservative Relative Precision at 90% Confidence	Percent Program Savings (BTU)
Electric	46	868	12%	15%	96.6%
Gas	12	167	14%	17%	3.4%
Overall	**58**	**1035**	**11%**	**14%**	**100%**

2.2.4 Achieved sample

DNV GL completed 4 additional site audits compared to the final sample design, increasing the total achieved sample to 62. Table 14 shows the achieved sample and final relative precision at 90% confidence by fuel type savings. The final relative precision for electric savings is 15% at 90% confidence, right at the conservative estimate from the sample design, while the final relative precision for gas savings is 22% at 90% confidence, slightly outside of the conservative estimate of precision.

The poorer relative precision for gas sites in the final sample compared to the sample design was due to basing the design on total site BTUs rather than optimizing around therm savings. DNV GL found an electric (kWh savings) error ratio of 0.82, meaning the variation in savings was larger than expected, and a gas (therm savings) error ratio of 0.42, meaning the variation in savings was smaller than expected. The error ratio is a summary statistic of variability of the ratio of verified to tracking system energy savings.

Table 14: Final precision for sample sites by fuel type

Fuel Saving Type	Sampled Sites	Relative Precision at 90% Confidence	Error Ratio
Electric	49	15%	0.82
Gas	13	22%	0.42

2.2.5 Expansion of sample results to the population

DNV GL used ratio estimation techniques to extrapolate the estimates of verified (ex-post) savings for the sampled sites into an estimate of ex-post gross savings for the program as a whole. Basically, if the projects are divided into strata with equal savings the number of projects in each stratum is unequal, with the smallest number of projects in the stratum with highest savings per project. When these strata savings are applied back to the population they must be weighted by our best estimate of the percent with which those projects are found in the population. The ratio estimation leveraged the statistical sample design described earlier and results in a quantification of program savings with measures of statistical precision and confidence intervals.

DNV GL compared the tracking system (ex-ante) estimates of savings for the sampled sites with the verified gross savings (ex-post) to calculate an adjustment factor (R_v) for each site and stratum that could be

applied to ex-ante savings estimates program-wide in order to return verified savings (ex-post) for the 2012-13 program. DNV GL used appropriate weights for each stratum to extrapolate the adjustment factor up to the overall program population. The formula for determining the adjustment factor is:

$$R_V = \frac{\sum_{j \varepsilon A} G_{Vj}}{\sum_{j \varepsilon A} G_{Ij}},$$

where

GIj = tracking estimate of gross savings for project j

GVj = verified gross savings for project j based on simulation modelling and installation rate.

A denotes the sample.

2.3 Energy consumption modeling and savings analysis

The following sections outline DNV GL's approach for estimating the site energy savings achieved by the projects sampled. The sections are divided between DI measures for which only verification was completed and other measures for which field data collection and energy modeling were completed. The specific methodology or combination or methodologies used at each site was dependent on the measures installed.

2.4 Direct install measure verification

For DI, leave-behind and/or appliance measures (e.g., showerheads, power strips, CFLs, and refrigerators) DNV GL verified the measure installation during the site visit. If there were multiple instances of the same measure installed at a site, DNV GL verified a sample using the intra-site sampling rules outlined in section 2.4.2. The results of this verification were used to calculate installation rates for each measure at the site. DNV GL then estimated site level savings for DI measures utilizing the same RTF or PSE deemed savings estimates that were used by PSE during the 2012-13 program cycle for each measure and the calculated installation rates. This evaluation methodology was consistent with the methodology used to estimate the original program savings forecast.

2.4.1 Installation rate determination

DNV GL utilized the results of the on-site audit to calculate an installation rate (IR) for each measure at a given site. The team compared equipment found in the sampled units to the DI tally sheets provided by Ecova (third party program implementer) that detailed which measures were installed in each unit to evaluate the IR for each measure. For example, if an on-site surveyor visited five units at a site that installed CFLs, the comparison might look something like Table 15.

Table 15: Example DI comparison sheet

Unit Number	CFLs Found On-Site	CFLs Reported in DI Tally
101	3	4
107	4	4
205	2	2

Unit Number	CFLs Found On-Site	CFLs Reported in DI Tally
209	1	2
320	1	2
Total	**11**	**14**

For this example, the installation rate for CFLs is 78.6% (or 11 divided by 14). Once the team determined the IR, they multiplied the IR by the claimed savings in the tracking data to determine the ex-post savings for the measure at the site.

Common area lighting installation rates were calculated slightly differently as the installation location was not always explicitly listed in the documentation provided by Ecova. While on site, the DNV GL team checked the common areas for the lighting equipment listed in the documentation and if the team found the expected equipment installed and the number of lamps on the invoice matched the number of lamps in the tracking data then the measure received a realization rate of 1. PSE calculated the ex-ante savings on a custom basis for common area lighting measures using the characteristics of the existing equipment found at the site and the new lighting equipment installed. In cases where those spreadsheets were included in the documentation, DNV GL reviewed PSE's calculations and found them to be reasonable.

2.4.2 Intra-site sampling for installation verification

When there were multiple instances of the same measure installed at a site, DNV GL sampled within the site to verify the installation rate with 20% precision at 90% confidence, as specified by the California Energy Efficiency Evaluation Protocols.[10] The equations describing the relationship are nonlinear hence the percentage of installations that need to be verified decrease as the number of instances of the measure increase. In Table 16 below, N (first row) is the total number of installations of a particular measure at a site and n (second row) is the number of observations required in order to get the specified precision on verification rate for that measure.

Table 16: Number of measures to sample

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

The following sampling scenarios occurred during the course of this project:

- When the location (i.e. tenant unit number) of installed measures was available in the audit files, as it is for many appliance measures, DNV GL only sampled units with expected measure installations. In some cases, this required DNV GL to work with PSE and Ecova to identify the location (i.e., unit numbers) of direct installation measures at each site when that information was not included PSE's program tracking data or the site specific audit files.

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

- Common area measures, such as lighting, were easy to find and verify as site auditors had access to all common areas.
- If no information was available on the location of the installation, DNV GL assumed that measures installed in tenant units were evenly distributed among all of the units at a particular site. DNV GL sampled measures according to Table 16, using a ratio to increase or decrease the number of units sampled as necessary.

For example, if 100 showerheads (N=100) were installed at a site then 15 showerheads need to be sampled for verification (n=15). If there are 150 units (U=150) in the complex then we would expect to find showerheads in 66% of the units and we would need to visit u=n*U/N units (or 22.5 units) to verify the required number of showerheads if showerheads are evenly distributed across the units. However, DNV GL capped the number of tenant unit audits at 20 for an individual site to avoid over burdening property managers and prevent scope creep. DNV GL calculated the u for each measure selected for an on-site audit and visited enough units to satisfy the largest u (capped at 20). Once the u was selected, all of the EE measures in those units were verified, so some measures achieved a better precision than 20% at 90% confidence.

2.4.3 Direct install results

Through observations made during on-site audits, DNV GL calculated installation rates for direct installation measures. While these installation rates cannot be extrapolated to the program population, they do provide insight about the persistence of measure installed directly by the program. As shown in Table 17, only around two-thirds of installed lighting (CFLs and LEDs) remained in place two to three years after installation which is much lower than the assumed measure life of each.

Table 17: DI measure-level observed installation rate

Measure	Number of Sites with Measure Installed	Total Measure Expected	Total Measure Observed	Observed Measure Installation Rate
Advanced Power Strip (IR) - Leave-Behind	1	16	2	13%
Clothes Washer Replacement Electric Water Heat/Electric Dryer	9	13	9	69%
Energy Star CFL - Direct Install	30	4,527	2,936	65%
LED - A-Lamp - Direct Install	14	198	129	65%
LED - Candelabra - Direct Install	10	114	83	73%
Refrigerator Replacement	33	77	66	86%
Showerhead - Max 1.5 gallons per minute (GPM) EWH - Direct Install	26	312	217	70%
Showerhead - Max 1.5 GPM Gas Water Heat - Direct Install	7	72	62	86%
Showerhead (CWA) - Max 1.5 GPM Electric Water Heat - Direct Install	2	32	24	75%
Smart Power Strip - Direct Install	9	150	20	13%

Water Heater Pipewrap - Direct Install	23	245	202	82%

Other DI measure observations include:

- Overall, the persistence of DI measures was lower than assumed by the program.[11]
- Power strips were found to have the lowest installation rate of any measure at just 13%.
- Anecdotally, DNV GL heard negative feedback from both property managers and residents at sampled sites about the quality of refrigerators installed by the program which could account for the observed measure installation rate (86%). PSE may have already addressed this issue in their 2014-15 program but it is worth pointing out as issues with measure quality can have an impact on future program participation.

2.5 Energy modeling methodology

For participant sites that installed weather-dependent (non DI measures) measures, DNV GL used the Targeted Retrofit Energy Analysis Tool (TREAT) software to model energy consumption and savings. The TREAT model is approved by the Department of Energy as energy audit software for all residential housing types, including multifamily. TREAT was selected by DNV GL because it contains detailed building material libraries, has the ability to estimate savings from combined retrofits (i.e., multiple measures) and offers reliable, market-tested energy analysis for multifamily. The project's audit data collection form (reviewed and approved by PSE in November, 2014) was specifically designed to match the TREAT software inputs to help ensure accurate results.

Each site specific energy model was built based on the post retrofit conditions using the information collected during the on-site energy audits and calibrated using post retrofit billing data (provided by PSE). Energy savings were determined using the model by setting input parameters for each of the energy efficiency measures installed through the program to their pre-retrofit baseline values. DNV GL aligned TREAT baseline assumptions with the site's project file or (where site specific data was insufficient) with RTF baseline assumptions. For budget reasons, it was outside the project scope to do a measure level savings analysis, changing one measure at a time. Instead, DNV GL calculated the total savings for all weatherization measures at a site using TREAT. When a site implemented both DI and weatherization measures the savings for the two types of measures were calculated independently and summed for the total site savings. Since the model was based on post–retrofit conditions it included all of the installed DI measures which allowed for relevant interactive effects on the weatherization measure savings (i.e. CFL impact on heating load). The weatherization measure savings were calculated as the "last measures in".

2.5.1 Model calibration

DNV GL used post retrofit billing data (i.e. actual energy use) to calibrate the TREAT model to the actual annual energy use of the sampled multifamily buildings after the installation of efficiency measures, making adjustments to certain model inputs when necessary. DNV GL calibrated the TREAT energy models using post retrofit conditions and post retrofit energy bills because that is the condition in which the energy auditors observed and collected data. Not only does this method allow interactive effects to be accounted for, DNV GL believes this approach yielded the most accurate estimate of energy savings for PSE's Multifamily Program and provided the highest level of confidence as the post retrofit model was based on data collected directly by our on-site auditors.

[11] PSE claimed savings assumed that 100% of DI measures were installed and stayed in place for duration of measure life.

For gas-only sites, where PSE is not the electric provider, DNV GL only calibrated the gas consumption using post retrofit billing data (from PSE) and relied on the TREAT model to estimate electric consumption.

Typically, model calibration is accomplished by adjusting input parameters until the annual consumption calculated using billing data closely matches the modelled (i.e. estimated) building consumption. DNV GL was careful to only modify the inputs within realistic levels, and to make sure that inputs were consistent with the data collected on-site and through surveys. The range of reasonable input values is detailed in Table 18 below[12]. Data collected from the on-site audits were never changed or used to calibrate the model as that data forms the basis for actual on-site conditions.

Table 18: TREAT model calibration input names and ranges

Input Variable Name	Load Category	Low Value	High Value	Units
Heating Thermostat set point	Heating	60	78	degrees F
Cooling Thermostat set point	Cooling	60	78	degrees F
Infiltration	Heating and Cooling	0.3	4	Air Changes per Hour (ACH)
Programmable T-Stats	Heating and Cooling	No	Yes	
Duct Leakage	Heating and Cooling	1	50	Cfm
Miscellaneous Plug Loads	Baseload	0	5,000	kWh
Lighting Hours On per Day	Baseload	3	12	Hours
Lighting Fixtures Wattage	Baseload	18	100	Watts
Lighting Fixture Counts	Baseload	1	15	fixtures per unit
HVAC Fan Hours On per Day	Baseload	0.2	3	Hours
Water Heater Demand	Baseload	0.5	1.5	Percentage of gal/day

2.5.1.1 Modelling inputs

After DNV GL calibrated the TREAT model (post retrofit), the inputs associated with the installed energy efficiency measures were changed to pre retrofit conditions which were detailed in the site specific audit files from Ecova. Where DNV GL could not reasonably find details on the baseline (pre retrofit) conditions, we deferred to Regional Technical Forum (RTF) assumptions or TREAT model defaults. The energy consumption estimates from the two models (pre and post retrofit) were compared to obtain the change in energy use which determined the site level energy savings.

[12] Calibration ranges were established by DNV GL, based on professional experience and lessons learned from similar modeling done on past projects, including PSE's Multifamily Airseal project.

The modelling input details used to assess impact for each measure were fully documented for each site that was modelled in TREAT.[13] DNV GL documented not only the values used in the baseline case (pre retrofit) and the energy efficiency measure case (post retrofit) for each input parameter, but also the inputs that were adjusted during calibration.

2.5.1.2 Model results

Site specific energy consumption model results were exported from TREAT and entered into a separate Excel document for data analysis and summary (Table 19). DNV GL's approach to energy savings modeling yielded site level results for the sampled sites which were expanded to the population (i.e., program level). The sample was not designed to yield statistically reliable results at the measure level, as the focus was verifying program level savings while maintaining a reasonable sample size.

[13] Cleaned dataset with site-specific model inputs and results will be delivered to PSE in tandem with this report

Table 19: Site-specific model results

Site Code	Reported Fuel Type	Model Annual Pre-Retrofit (kWh)	Model Annual Post Retrofit (kWh)	Model Annual Savings (kWh)	Model Annual Pre Retrofit (therms)	Model Annual Post Retrofit (therms)	Model Annual Savings (therms)	Claimed Tracking Savings - modeled measures (kWh)	Claimed Tracking Savings - modeled measures (therms)
7	Electric	78,248	69,592	8,656	0	0	0	14,231	0
34	Electric	237,616	210,280	27,212	0	0	0	41,838	0
40	Electric	371,502	347,999	23,503	0	0	0	43,187	0
89	Electric	425,875	317,081	108,795	0	0	0	87,865	0
101	Electric	892,882	768,527	124,355	0	0	0	128,228	0
120	Electric	2,540,605	2,432,224	108,381	0	0	0	249,277	0
145	Gas	0	0	0	5,561	4,784	777	0	1,014
153	Gas	0	0	0	42,814	38,935	3,879	0	4,111
154	Gas	0	0	0	22,032	19,698	2,334	0	2,800
156	Gas	0	0	0	92,203	80,149	12,054	0	23,262
190	Electric	301,785	282,113	19,672	0	0	0	19,104	0
192	Electric	316,616	286,047	30,569	0	0	0	37,062	0
203	Electric	894,184	650,619	243,565	0	0	0	33,045	0
284	Electric	4,261,735	3,755,774	505,961	0	0	0	367,891	0
331	Electric	182,799	174,451	8,347	0	0	0	10,786	0
357	Electric	1,450,692	1,389,029	61,663	0	0	0	129,549	0
368	Electric	1,353,118	1,299,649	53,469	0	0	0	73,865	0
385	Electric	727,585	556,620	170,966	0	0	0	233,370	0
391	Electric	2,483,004	1,845,982	637,022	0	0	0	303,789	0
394*	Both	0	0	0	123,944	114,973	8,971	38,824	0
395*	Both	3,073,008	2,623,918	449,090	0	0	0	632,505	3,617

Notes: *Site 394 - PSE tracking data indicated kWh savings from floor insulation, however, DNV GL found gas space heat during the on-site audit. Site 395 - DNV GL did not find gas heat in any of the units and is unsure what the therm savings in the PSE tracking data were attributed to.

2.5.2 Mixed DI and non-DI sites methodology

For participant sites that received both DI and weatherization measures, DNV GL completed both an installation verification for DI measures and the building modeling in TREAT for weatherization measures using methodologies described in more detail earlier. DNV GL summed the DI savings (DI installation rate multiplied by deemed savings from PSE tracking data) with the weatherization savings modeled in TREAT to establish the total site savings. The site savings were then compared with PSE's claimed savings to determine the site level realization rate.

2.6 Impact evaluation results

Through a combination of measure verification, installation rate analysis, and building modeling, DNV GL found a gross electric savings realization rate of 0.86 with 15% precision at 90% confidence and a gross gas savings realization rate of 0.77 with 22% precision at 90% confidence. As shown in Table 20, the 2012-13 program achieved evaluated electric savings of 37.9 million kWh and gas savings of almost 119,000 therms. Table 20 also shows the range of evaluated savings based on the achieved precision at 90% confidence.

Table 20: 2012-13 program reported and evaluated energy savings

	Program Reported Savings[14]	Realization Rate	Evaluated Savings	Precision at 90% Confidence
Electric (kWh)	44,208,769	86%	37,900,908	15%
Gas (therms)	155,082	77%	118,664	22%

	Program Reported Savings[9]	Realization Rate	Evaluated Savings	Precision at 90% Confidence	Evaluated Savings Range at 90% Confidence		Evaluated Savings Range (%) at 90% Confidence	
					Low	High	Low	High
Electric (kWh)	44,208,769	86%	37,900,908	15%	32,215,772	43,586,044	73%	99%
Gas (therms)	155,082	77%	118,664	22%	92,558	144,770	60%	93%

[14] Reported to DNV GL by Puget Sound Energy

3 PROCESS EVALUATION

The following sections discuss the process evaluation methodology employed by DNV GL as well as the key results of the study.

3.1 Process evaluation overview and objectives

The objectives of the process evaluation of the PSE Multifamily Retrofit program included:

- Identifying potential improvements in program design and operating procedures
- Identifying and characterizing barriers to participation and measure implementation among participants to support development of effective program marketing and delivery approaches
- Assessing customer satisfaction with the program and products installed

To achieve the process evaluation objectives, the DNV GL team conducted the following activities:

- Completed in-depth interviews with PSE program staff and representatives of the program delivery partner Ecova to gain their perspectives on program operation, market conditions, and program effectiveness
- Developed a program logic model to guide research and development of recommendations for program changes, based on in-depth interviews with program staff and review of program materials
- Fielded CATI surveys of participating customers and stalled participants. We surveyed these program participants and stalled participants to learn how they became aware of the program, their energy efficiency practices and barriers, the program's level of influence over their energy efficiency activities (e.g., net-to-gross estimates), and their level of satisfaction with the program

3.2 Process evaluation methodology

This section details the methodology and sampling approach for both the stalled participant and full participant surveys. The results of the stalled participant and full participants surveys can be found in APPENDIX D and APPENDIX E, respectively.

3.2.1 Stalled participant CATI surveys

DNV GL designed and managed CATI surveys of stalled participants (PSE multifamily customers who initiated program participation, primarily by receiving program audits, but for whom we have no record of their implementing energy efficiency projects through the program). The surveys captured information about program awareness among these customers, their recall of the audit recommendations, what barriers they encountered in trying to implement these energy efficiency recommendations, elements of the program that could be used to mitigate those barriers, and their levels of program satisfaction. Seventy stalled participants completed surveys from April 30 through May 14, 2015.

3.2.2 Stalled Participant sampling and dispositions

This section describes how we developed our sample frame for the stalled participant survey. It also describes the disposition of completed surveys.

3.2.2.1 Development of the sample frame

DNV GL issued a data request to PSE for stalled participants who had received an audit and/or DI measures in 2012 or 2013, but who had no record of receiving a rebate and becoming an actual program participant. PSE sent the list on December 1, 2014.

To create the sample frame, DNV GL first worked to get phone numbers for all the properties in the data file. The initial data file provided by PSE had 579 properties, 269 of which had phone numbers. For the other 310 properties, DNV GL sent the information to a third party phone number provider, Relevate. Relevate was able to match phone numbers for 208 of the properties. Table 21 provides an overview of the steps between the initial data file and the final sample frame, along with how many properties were dropped out at each stage of the process.

Table 21: Development of stalled participant sample frame

Stage	Number
Properties available in initial data file	579
Properties removed because Relevate could not find a number	-102
Properties removed because same number listed in participant data file	-78
Final number of properties	399
Final number of contacts (max of 3 properties per contact)	**358**

3.2.2.2 Sample design and selection

Once the sample frame of 358 contacts was finalized, DNV GL chose to survey the whole population in the sample frame. Historically nonparticipants have low responses and we assumed that to reach our targeted number of 70 completed surveys we would need all 358 customers in the sample frame, assuming a 20 percent response rate. In order to reduce burden on the respondents and increase the response rate, we sampled only three sites for each of the property managers with more than three properties. In the three cases where a contact had more than three properties, we randomly picked which three properties we would ask about in the survey. DNV GL removed four properties from the sample frame as a result of this step.

3.2.2.3 Survey fielding

The survey instrument collected data from a series of questions divided into the following five categories (see Appendix A for the full survey instrument).

1. Introduction
2. General decision-making process
3. Review of services received
4. Participant satisfaction
5. Firmographics

DNV GL contracted with Pacific Market Research (PMR) to field the surveys using CATI software. To ensure quality interviews, DNV GL staff provided PMR staff with Q&A documents and training on the purpose of the survey. We also tested the CATI program prior to launch to confirm PMR programmed the survey accurately. Additionally, we monitored interviews on the first day of survey fielding to ensure interviewer quality and to listen for any questions that may need to be tweaked to enhance customer comprehension. The surveys were in the field from April 30 through May 15, 2015. The overall response rate for both the site and contact level was 20% with 70 completes out of 358 contacts and 78 completes out of 395 properties (Table 22).

Table 22: Stalled participant interview response rates

Respondent Level	Respondent Count	Response Rate
Property manager/owner level (n=358)	70	19.6%
Property level (n=395)	78	19.7%

3.2.3 Full participant CATI surveys

DNV GL designed and managed CATI surveys of 2014 PSE Multifamily Retrofit Program customers who were full participants. These surveys captured information about program awareness among these customers, the influence the program had on their behavior, potential spillover, and their levels of program satisfaction. A total of 105 full participants completed the survey conducted May 22, 2015 to June 12, 2015.

3.2.4 Full participant sampling and dispositions

This section describes how we developed our sample frame for the full participant survey. It also describes the disposition of completed surveys.

3.2.4.1 Data sources

DNV GL issued a data request to PSE for participants who had received program measures in 2014. PSE sent the list March 17, 2015.

3.2.4.2 Development of sample frame

To create the sample frame, DNV GL first worked to get phone numbers for all the properties in the data file. The initial data file provided by PSE had 574 properties, 417 of which had phone numbers. For the other 157 properties, DNV GL sent the information to Relevate, which matched 72 additional properties. Table 23 provides an overview of the steps between the initial data file and the final sample frame, along with how many properties were dropped out at each stage of the process to end up with 415 contacts in the sample frame.

Table 23: Development of full participant sample frame

Stage	Number
Properties available in initial data file	574
Properties removed because Relevate could not find a number	-85
Final number of properties in sample frame	489
Final number of contacts (max of 3 properties per contact)	**415**

3.2.4.3 Sample design and selection

Once we finalized the sample frame of 415 contacts, we chose to do a census aiming to achieve 125 responses, which would have required a 30% response rate. To reduce burden on the respondents and increase the response rate, we sampled a maximum of three properties for each of the property managers with more than three properties. In these cases where a contact had more than three properties, we used a simple random sample to determine which three properties we would ask about in the survey. DNV GL removed a total of 36 properties during this stage for a total of 453 properties in the sample.

In addition to sampling at the property level, this sample also had sampling at the measure level, as this survey asked questions related to program influence at the measure level. In these cases, the survey combined DI measures together and asked about a maximum of three standard rebated measures. If a participant received more than three measures as part of the program, we used a simple random sample to determine which three measures we would ask about.

3.2.4.4 Survey fielding

The survey instrument for the full participants collected data from a series of questions divided into the following seven categories. Appendix B contains the full survey instrument.

1. Introduction
2. Review of services received
3. Awareness of the program
4. Program influence
5. Like spillover/future measures
6. Participant satisfaction
7. Firmographics

DNV GL contracted with Pacific Market Research (PMR) to field the surveys using CATI software. To ensure quality interviews, DNV GL staff did the same quality control measures as we described above for the stalled participants. We provided PMR staff with Q&A documents and training on the purpose of the survey, tested the CATI program prior to launch to confirm PMR programmed the survey accurately, and monitored interviews on the first day of survey fielding to ensure interviewer quality and to listen for any questions that

may need to be tweaked to enhance customer comprehension. The surveys were in the field May 22 through June 12, 2015. The overall response rate was 25% for the contact level with 105 completes out of 415 contacts and 24% for the site-level with 109 completes out of 453 properties (Table 24). While the number of completed surveys was below the target of 125 completes, the response rate was sufficient for this analysis.

Table 24: Participant interview response rates

Respondent Level	Respondent Count	Response Rate
Property manager/owner level (n=415)	105	25%
Property level (n=453)	109	24%

3.3 Full and stalled participant survey results comparison

This section will compare survey results from the full and stalled participant surveys.[15] Assessing the differences between the two groups can help give insight into what might have caused the stalled participants to not fully participate in the program. We conducted significance testing on all results reported in this section. Unless otherwise noted, the differences we discuss in the text of this section are statistically significant. We define statistically significant as a difference that falls within the 90% confidence interval using an unpooled z-test.

We conducted CATI surveys with 105 full participants and 70 stalled participants in spring 2015. For detailed information on the sample design and selection process for the stalled and full participants see sections 4.1 and 5.1 respectively.

Arguably, one of the biggest differences that may have affected participation was whether the participant received suggestions on energy efficient improvements. While the full and stalled participants had similar levels of recall for DI measures and getting an energy audit, full participants were more likely to recall getting suggestions on energy efficiency improvements. Not receiving suggestions would naturally lead to lower levels of participation because customers may not know what measures they are eligible for, who to reach out to for additional information, or that there is another stage of the program. A third explanation for the difference could be that stalled participants may not have had as many opportunities for energy efficiency, so perhaps it was not that they did not receive suggestions, but rather that there were no suggested improvements for the contractors to make or opportunities which were big enough to warrant action.

3.3.1 The effects of firmographics and building characteristics on participation

Firmographics can all affect a property manager's ability or decision to participate in a program. Differences in firmographics between full and stalled participants could help explain why stalled participants did not fully participate in the program.

[15] Stalled and full participant survey results can be found in APPENDIX D and APPENDIX E, respectively.

We asked participants whether they owned or rented the property in question and the location of the property management firm. These firmographics were similar for the stalled and full participant groups, indicating these factors did not strongly affect participation rates.

When we asked respondents whether they worked onsite at the property, stalled participants were more likely to report working onsite at the property, than the full participants (Figure 3). A large portion of the difference likely comes from the full participant sample having more respondents reporting that they were condo owners, as discussed below.

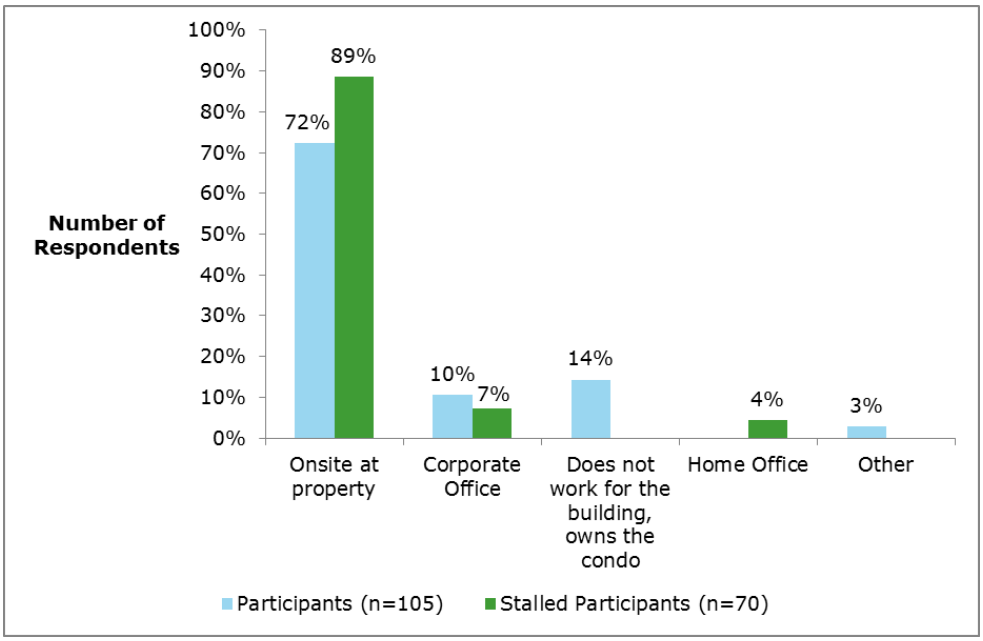

Figure 3: Location where respondent works by participant group

We asked respondents to provide their job title and the large majority (>70%) of respondents in both groups said they were a manager of some kind (Figure 4). There were no statistically-significant differences between any of the job titles held by the full participants versus the stalled participants with the exception of the percentage of respondents identifying themselves as condo owners. One of the program actors mentioned that connecting to the correct decision-maker was a barrier to recruiting new program participants. While this may be a barrier to recruiting new participants into the program, the general similarity in job titles between full participants and stalled participants indicates that not being able to reach the right decision-maker was not an explanatory factor as to why stalled participants did not move forward in the program.

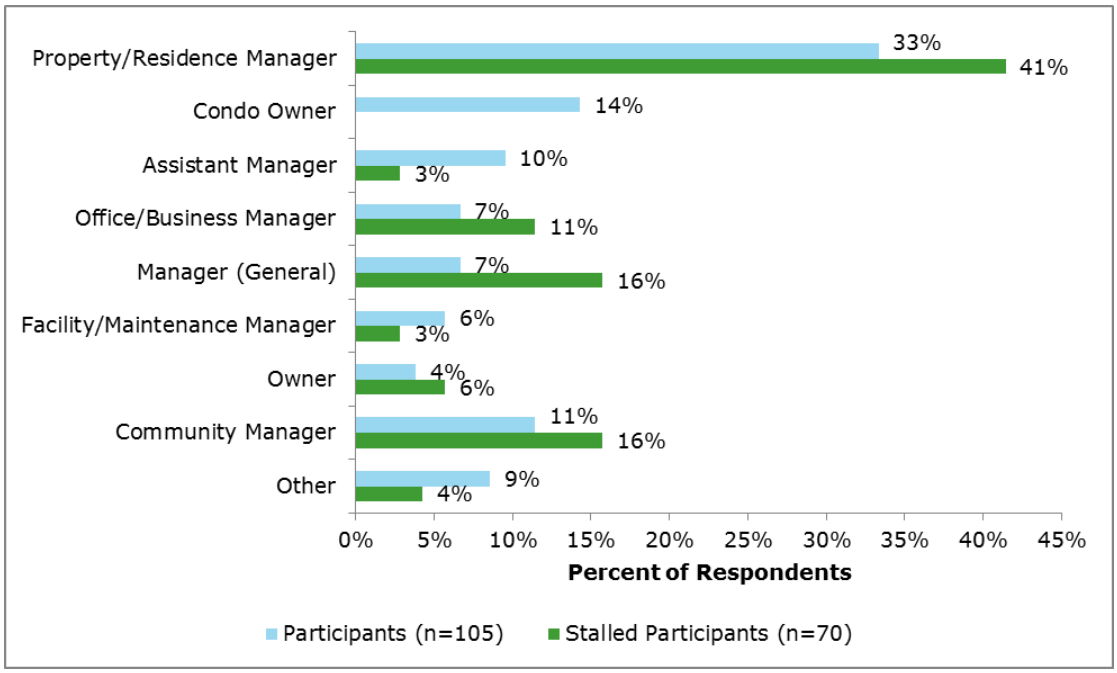

Figure 4: Job title by participant group

One possible explanation for the higher percentage of condo owners in the full participant group is that condo owners would have more of an incentive to implement recommended energy-efficient measures because they do not face split-incentive barriers. Another plausible explanation is that the program actor interviews revealed that the program has recently placed more emphasis on targeting the condo market. This would explain why the more recent full participant sample has more condominium owners than the older stalled participant sample.

Full participants reported a slightly higher average number of properties managed (57 properties) compared with stalled participants (49 properties), but it was not a statistically-significant difference. However, as shown in Figure 5, full participants were more likely to report they managed only one property than the stalled participants (22% versus 4%). This is largely due to the higher proportion of self-reported condo owners (14%) in the full participant sample vs. the stalled participant sample.

We asked both the full participants and the stalled participants whether their property was an apartment building, a condominium, or something else. Figure 5 shows that the full participants were much more likely than the stalled participants to identify their properties as condos, which is similar to findings discussed earlier.

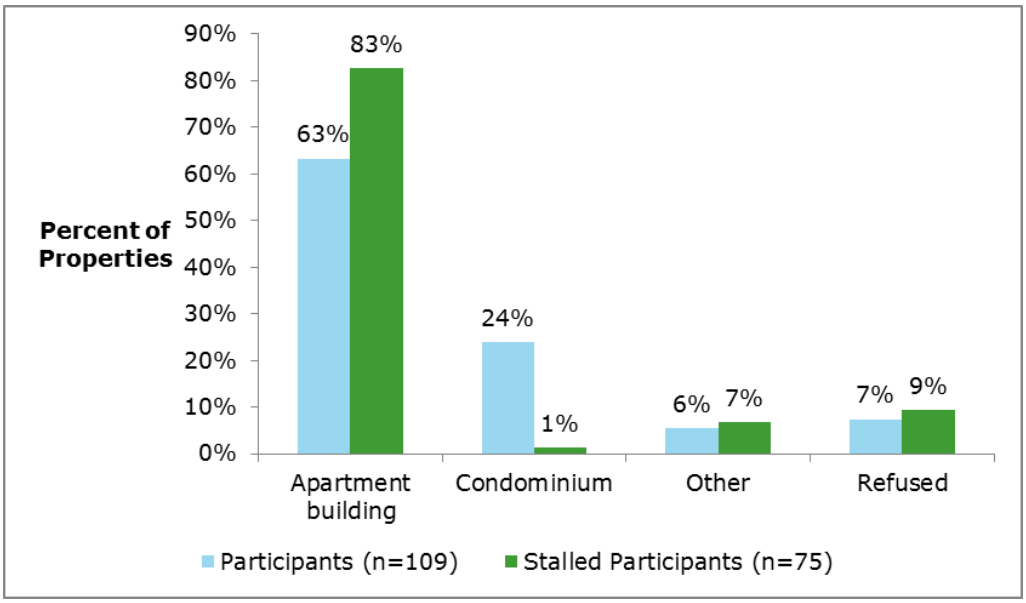

Figure 5: Type of property by participant group

We asked both the full participants and the stalled participants about the age of their properties. The reported construction dates of the properties ranged from pre-1940 to present day (Figure 6). The stalled participants reported a significantly higher proportion of properties built prior to 1940 (12% versus 4%). While one might expect old properties to have a need for updated equipment, it is possible the barrier of cost to come up to code could be too high, or that the technology may not be compatible with older plumbing. It is also likely that older properties have higher general maintenance costs and therefore maintenance projects may be absorbing capital funds that might otherwise go to energy efficiency projects.

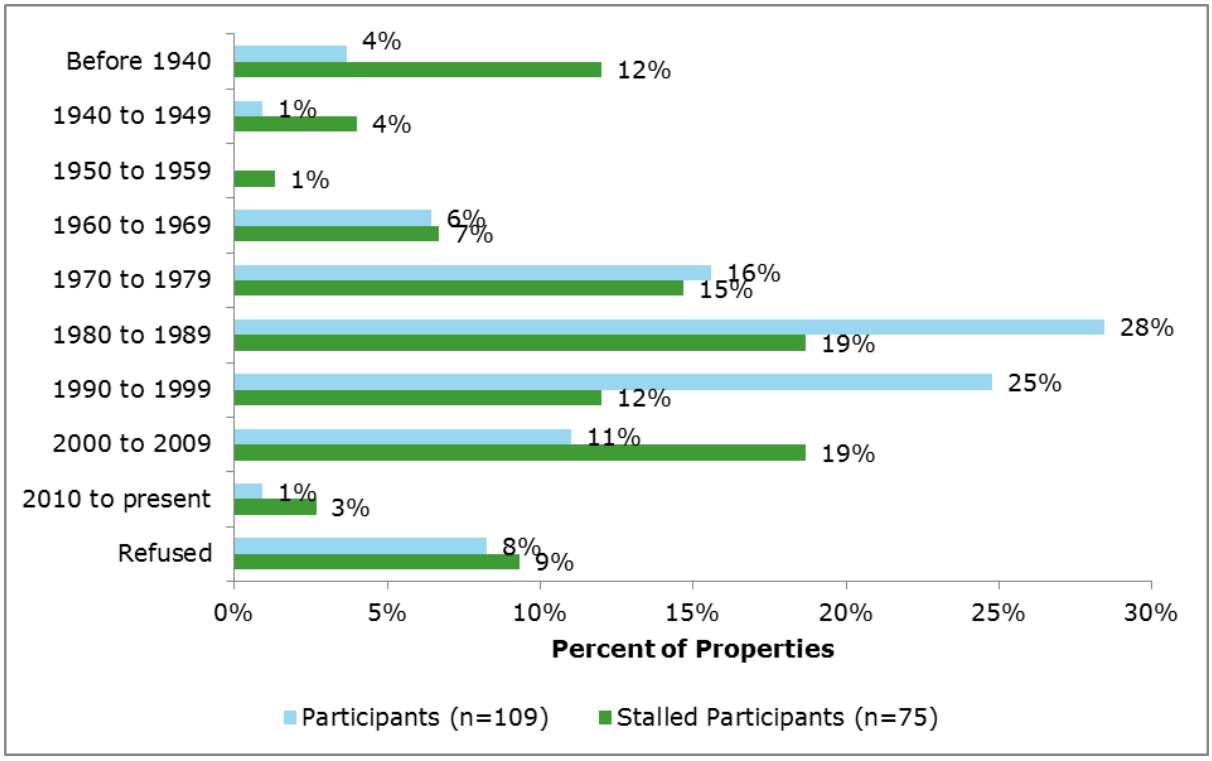

Figure 6: Age of property by participant group

We asked both groups to report the general income levels of the tenants in their property. Full participants were much more likely than stalled participants to report having mostly high income tenants (11% to 1%). The stalled participants were more likely to report having a somewhat diverse range of incomes, with low and middle income tenants (23% to 11%). As shown in Figure 7, small differences existed between the groups in other categories, but none of those differences were statistically-significant.

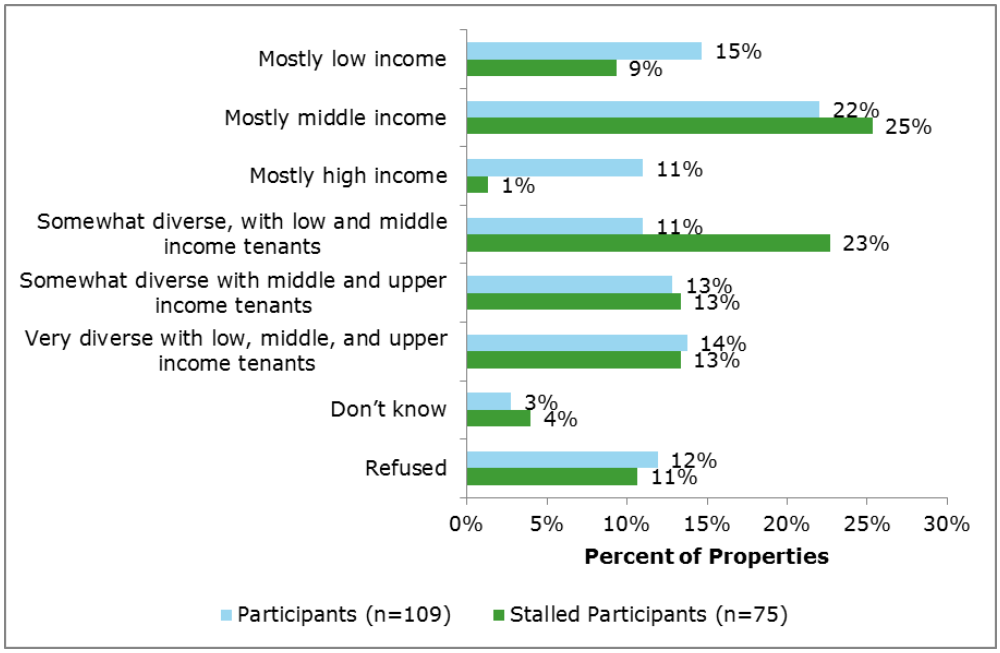

Figure 7: Tenant income-level by participant group

This difference in tenant incomes, with higher income tenants having more representation in the participant category, could help explain why the stalled participants did not progress through the program. In higher income buildings, having top-line energy efficient equipment could be a selling point for them to increase competitiveness against other high income apartment buildings and condominiums which may make environmental-friendliness a selling point. This would reduce the split-incentive barrier, which assumes multifamily property managers would not get any benefit from upgrading the tenant units. In contrast, in multifamily buildings with lower-income tenants, there is a lower likelihood of tenants moving out to get newer or better amenities due to the cost of moving. Therefore managers of these properties would have less incentive to make energy-efficient improvements due to the split-incentive barriers. Additionally, higher income tenants in condominiums would be more likely to have the funds to pay for new equipment themselves.

Theory suggests that when tenants pay their own utility bills, there is a greater chance of split-incentive barriers because landlords have no incentives to purchase energy-efficient equipment. When we asked both full participants and stalled participants whether tenants pay for their own utility bills, the percentage of tenants who pay their own bills was not different to a statistically-significant degree between the two groups. This suggests that the split-incentive barrier was not an explanatory factor as to why stalled participants did not progress further in the program. Stalled participants did report a statistically significantly higher percentage of tenants who pay some of their utilities, but not all. Both groups reported similar levels of customers with all utilities included (Figure 8). The proportion of buildings with individual meters versus master-meters for both electric and gas was similar across the two groups, as was the breakdown for centralized versus individual heating and cooling systems.

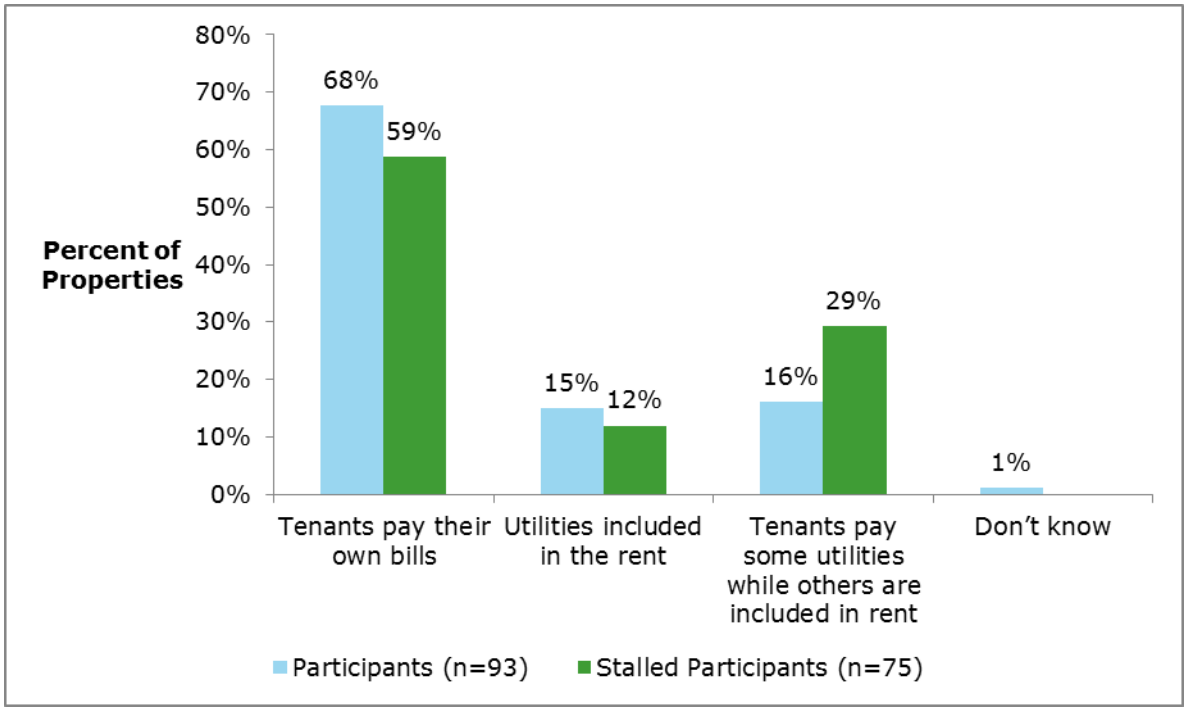

Figure 8: Tenant responsibility for paying utilities by participant group[16]

3.3.2 Respondent knowledge of services received

In this next section we will review the differences between stalled and full participants' recall of the various parts of the program.[17] Overall, full participants had higher recall than stalled participants, which is likely in part due to the survey being conducted closer to when they received the services (around one year later), while stalled participants received their survey several years after receiving services.

[16] Those who reported being condo owners were not asked this question.

[17] All 70 stalled participants received a question related to whether they remembered participating in the program. Initially, those who did not remember skipped to the next section of the survey. However, the high number of respondents who said they did not know prompted us to change the skip logic to ask this question for all respondents. Due to skip logic change occurring after the first day of interviewing, only 61 of the 70 respondents received the questions related to the services received.

The survey first asked the two participant groups whether they recalled receiving an energy audit. One might expect a higher percentage of stalled participants to not remember if they got an audit since they received services several years ago, while full participants received services in 2014. Yet the two groups had similar levels of recall for receiving an audit, with less than half recalling the audit (Figure 9). The stalled participants had a higher percentage of those who said they did not know if they got an audit, but it was not statistically significantly higher.

This lower level of audit recall by both stalled and full participants indicates a potential lack of awareness about the audit that occurs during this program. Other reasons could be that the person answering the survey was not the person onsite with the auditor and was not aware of exactly what happened during the visits. In either case, it does not seem that the audit itself made a significant impact on the decision to participate in the program.

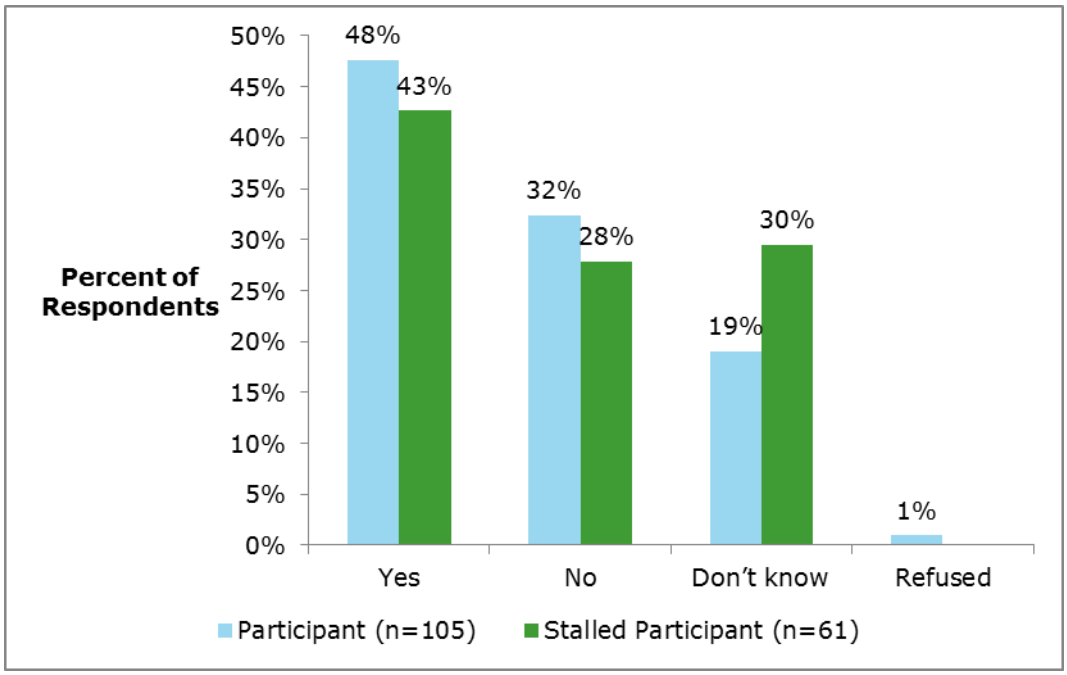

Figure 9: Recall of energy audit by participant group

The survey then asked full and stalled participants whether they recalled receiving DI measures. Again, the two groups had similar levels of recall, with about 75% of each group recalling receiving DI measures (Figure 10). The fact that both groups had similar recall of the audit and the DI measures indicates that the stalled and full participants received similar services at the outset. This suggests that it was something happening after the initial audit and DI that kept the stalled group from fully participating.

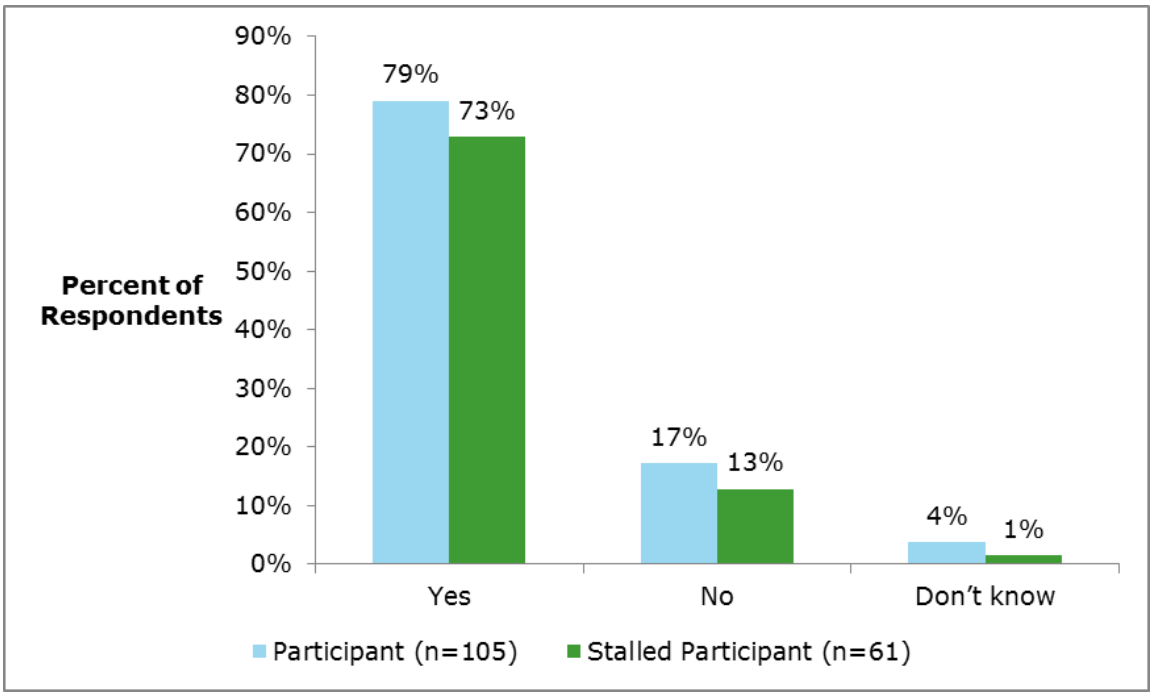

Figure 10: Recall of receiving directly installed measures by participant group

As shown in Figure 11, full participants had a significantly higher recall of receiving suggestions for energy efficiency improvements than stalled participants (49% versus 24%), while stalled participants had a significantly higher proportion say they did not know if they received services. There are many possible explanations for this. One possibility is that the longer passage of time led to lower recall of the measures for the stalled participants. Another possibility is that the stalled participants who said "don't know" received fewer audit recommendations and therefore had less reason to participate in the full program. A third possible explanation is that since the full participants implemented some of the measures recommended in the audit, they were more likely than the stalled participants to remember these recommendations. Another explanation, mentioned earlier, is that the respondent wasn't working at the site at the time of the audit or retrofit work.

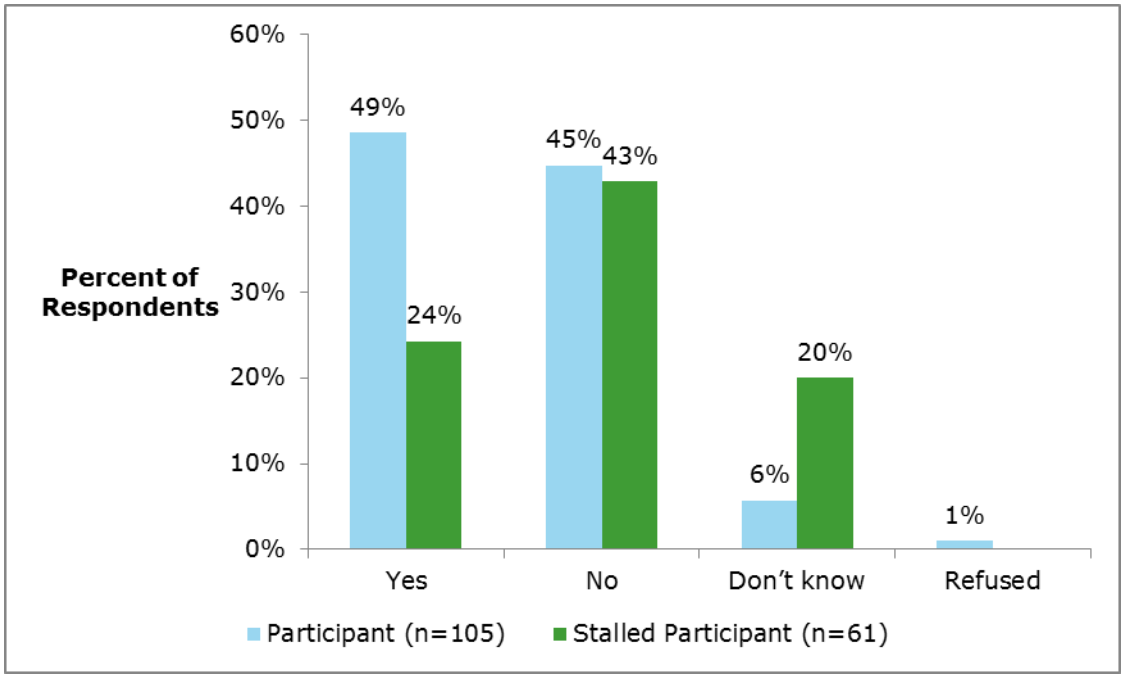

Figure 11: Recall of suggestions for energy efficiency measures by participant group

We asked participants whether they received rebates from PSE for implementing energy efficiency improvements recommended by the program energy audit. Full participants had a significantly higher recall of receiving PSE rebates or incentives than stalled participants (50% versus 29%). Since receiving a program rebate for a measure is the main differentiator between the full and stalled program participants, we would actually expect to see a much larger difference between these response rates.

The 40% of full participants who said they did not receive a PSE rebate is surprising because their participation was relatively recent and so one would not expect many to have forgotten about the measures. This low level of full participant recall should be a concern for the program since it will reduce levels of program attribution (e.g., increase free ridership). It is possible that some of these full participants were unaware of the rebate because their contractors took the rebates and gave them line-item discounts instead, which is allowable under the current program. In fact, Tier 1 Contractor Alliance Network (CAN) members

are required to provide instant rebates. However, in these cases, one would assume that the contractors would still mention the discount as being program-influenced. For larger property management companies it is possible that program rebate checks went to a corporate accounting department rather than to the onsite survey respondent.

The 29% of stalled participants who said they received a PSE rebate is also an unexpected result (Figure 12). One possibility is that some of the stalled participants were actually full program participants and they were misclassified due to the inherent difficulty of matching records from different tracking databases or because much time had passed between the program energy audit and the implementation of the energy efficiency project. It is also plausible that some of these stalled participants may have simply considered the DI measures as rebated measures. Other possibilities include them installing program-rebate-eligible measures that were not recommended by the audit or them mistaking vendor rebates for PSE rebates.

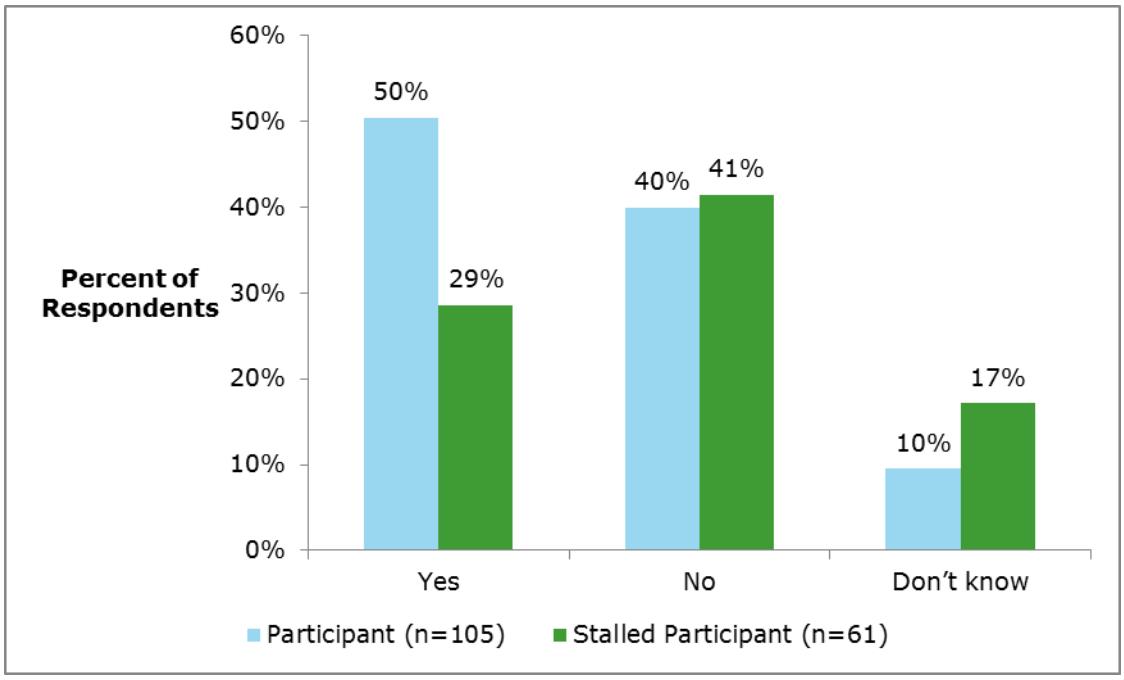

Figure 12: Recall receiving rebates or incentives by participant group

Finally, we asked both groups whether they received assistance from PSE in finding contractors to do the installations. Again, a significantly higher proportion of the full participants (44%) reported they received assistance in finding contractors to install energy-efficient measures than did the stalled participants (17%). This could be due to full participants more likely to reach out for contractor assistance because they had decided to implement the recommended measures (Figure 13). However, it is also possible a lack of assistance finding a contractor contributed to stalled participants not installing any measures. A third possibility is that they did receive program assistance with contractors but they said they did not because they had simply forgotten about it or because the person who had received the assistance was no longer there. These issues of forgetfulness and employee churn are likely to be greater for the stalled participants because their interaction with the program was further back in time.

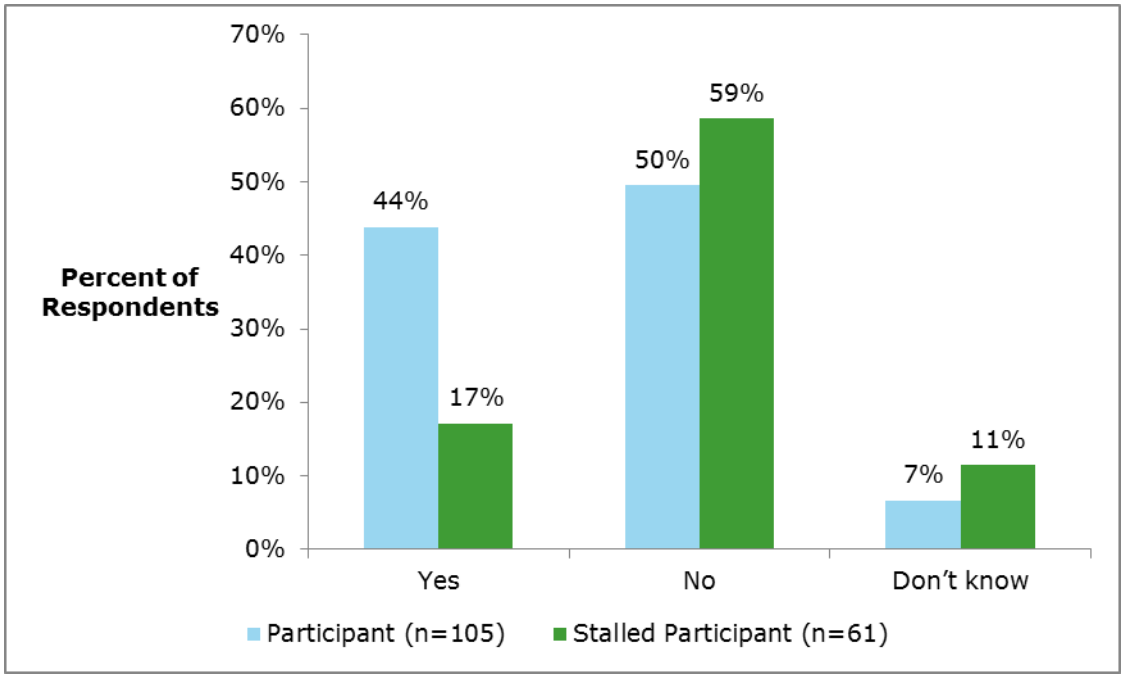

Figure 13: Recall receiving assistance finding a contractor

3.3.3 Actions outside of the program

We asked respondents whether they had installed any recommended measures for which they have not applied for a program rebate. As shown in Figure 14, the stalled participants who recalled the recommended measures were significantly more likely to have said they installed measures, but did not apply for a rebate than the full participants (61% versus 16%). This higher percentage of stalled participants is what we would expect since, by definition, stalled participants are those who did not turn the audit recommendations into program-rebated measures. The stalled participant responses should be considered a form of participant spillover. This is because the program audit influenced their decision to install these measures but since the stalled participants did not apply for program rebates, the program never claimed the energy savings from these measures.

The most common measure mentioned by the stalled participants was the CFL fixture, with 55% of stalled participants who installed measures saying they installed CFL fixtures (compared with 6% of full participants who said they installed this measure). In contrast, the full participants were more likely to say they installed LED fixtures. This difference is likely due to a program switch from CFLs to LEDs between the time the stalled participants received their audits (2010-13) and when the participants received theirs (2014).

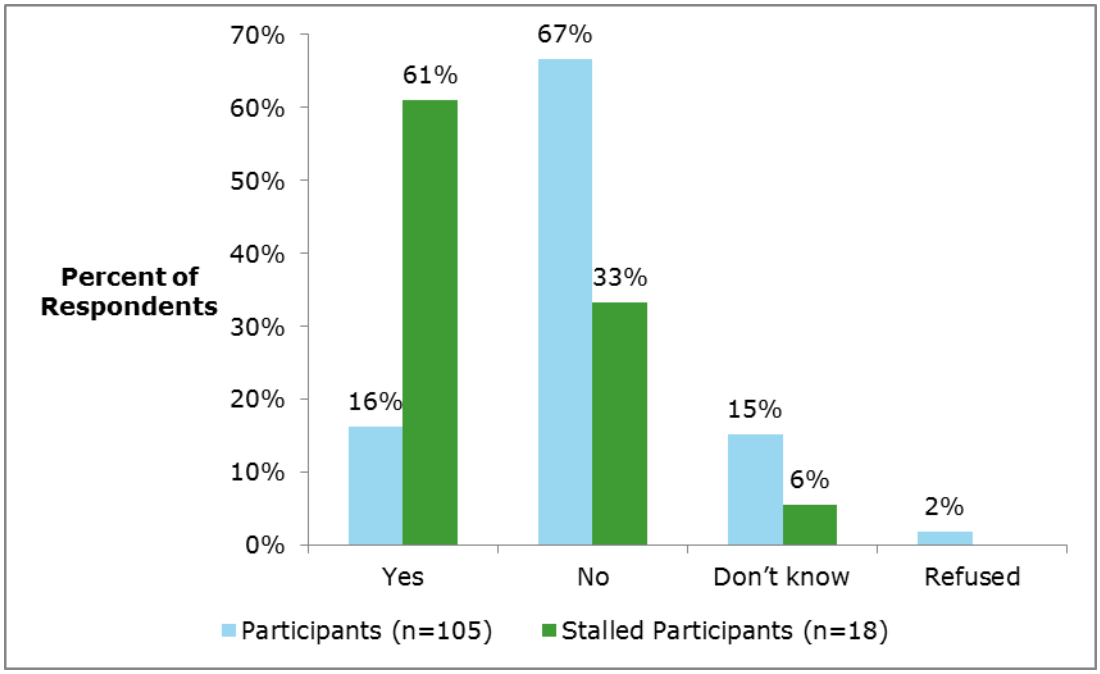

Figure 14: Have installed recommended measures, but have not applied for rebates[18]

We asked the two groups about future plans for installing any more audit recommendations. Sixteen percent of full participants reported they installed all their recommendations, while zero percent of stalled participants said that they did. This is in line with the main difference between the two groups. There was no difference between audit recommendations they do not plan to install, with only 5% of each group reporting there were recommendations they were not planning to install. When asked why they did not plan to install additional measures, both groups mentioned lack of financial resources to do so. Program actor interviews corroborate this reason, as lack of capital to initiate projects was the main barrier mentioned by program actors.

[18] All full participants received this question. We only asked stalled participants who said they recalled the recommended measures this question.

3.3.4 Satisfaction

We asked both groups about their satisfaction with various aspects of the program. When we compared the responses of the full participants with those of the stalled participant in terms of the percent who were satisfied with various aspects of the program (4 or 5 ratings one a five-point scale where 5 equaled "very satisfied"), the full participants were much more satisfied than the stalled participants (Figure 15). All these differences were statistically significant except the one for the DI contractors.

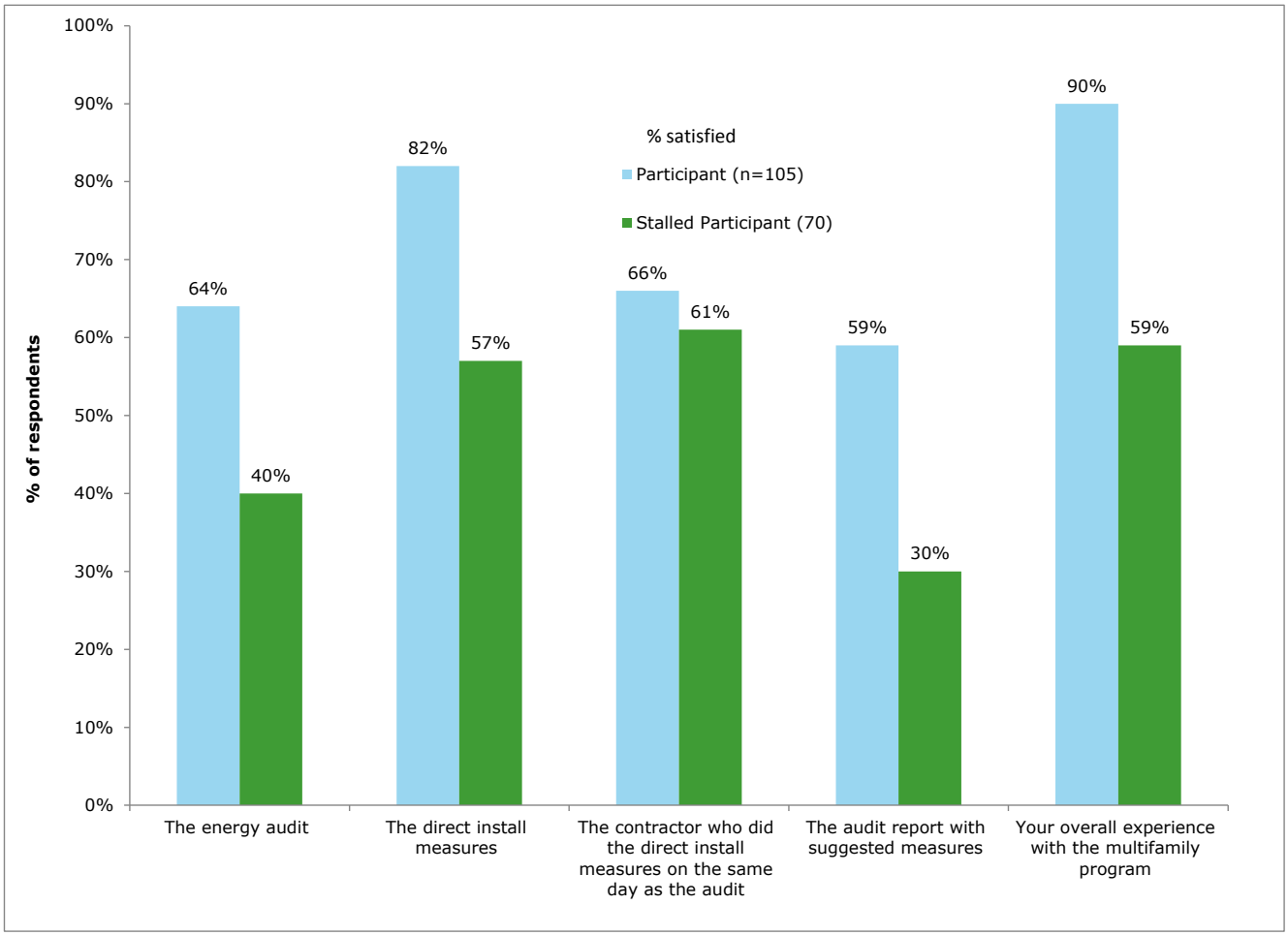

Figure 15: Satisfaction by participant group

Yet these lower satisfaction levels for the stalled participants are somewhat misleading since stalled participants were more likely to give "don't know" or "not applicable" responses than the full participants. This corroborates their higher proportion of "don't know" responses we mentioned in the services received section up above. As mentioned earlier, this could either indicate lower recall from receiving the services several years ago, or it could be due to differences in the services given to the stalled versus the full participants.

Therefore a slightly more fair comparison of the satisfaction ratings of full participants and stalled participant would be to look at the average satisfaction ratings since these exclude the respondents who gave "don't

know" or "not applicable" responses.[19] Figure 16 displays the average satisfaction score by participant group for those that gave a numerical response on a scale from 1 (very unsatisfied) to 5 (very satisfied).[20] When comparing average satisfaction levels between the full participants and stalled participants, only the overall experience with the program has a statistically-significant difference. Full participants had a higher level of satisfaction (mean of 4.59) compared with stalled participants (mean of 4.30). This is likely due to them receiving more benefits from the program than the stalled participants. However, it is also possible that dissatisfaction with the program caused some stalled participants to not progress any further.

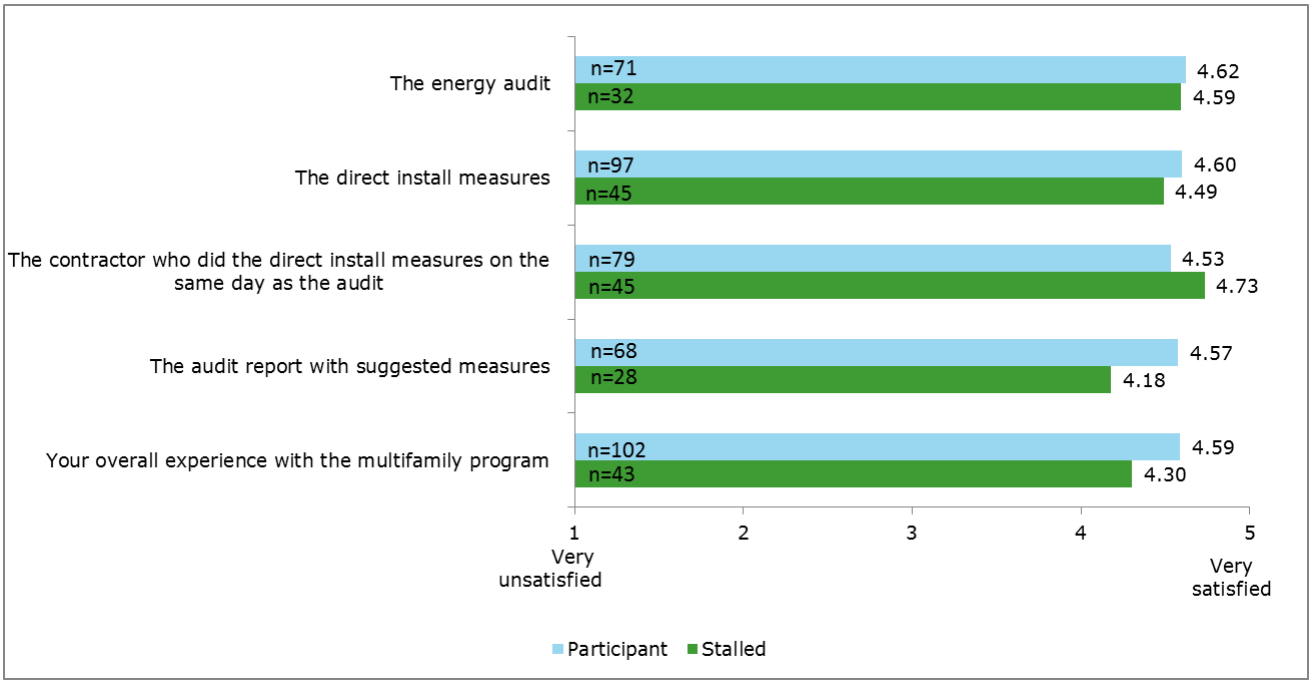

Figure 16: Mean satisfaction score by participant group

While satisfaction was high overall, several issues came up in both surveys. Several common issues with the audit report were not getting suggestions they were already aware of, not getting measures they wanted to install, and not having enough information on the next steps, such as finding contractors. Another complaint was not being pleased with the performance of the equipment. Respondents from both surveys who were less than satisfied with the DI measures and the program overall mentioned subpar equipment as a reason they were not satisfied. Others reported being displeased with the contractors and/or their work. During the program actor interviews, an interviewee mentioned that routine inspections have uncovered subpar work done by the some of the installation contractors.

Finally, we asked both groups what suggestions they had for improving the program. Both groups mentioned that providing more program details and using better quality products (i.e., appliances and bulbs)

[19] We say "slightly more fair" since removing the "don't know" and "not applicable" responses" probably does bias the satisfaction ratings somewhat since some of the lack of recall may be due to negative program outcomes (e.g., a program energy audit that was not very memorable).

[20] Other acceptable responses included "don't know", "refuse to answer" and "not applicable".

would improve the program. Figure 17 shows some of the other suggestions. Over half of each group did not have any suggestions.

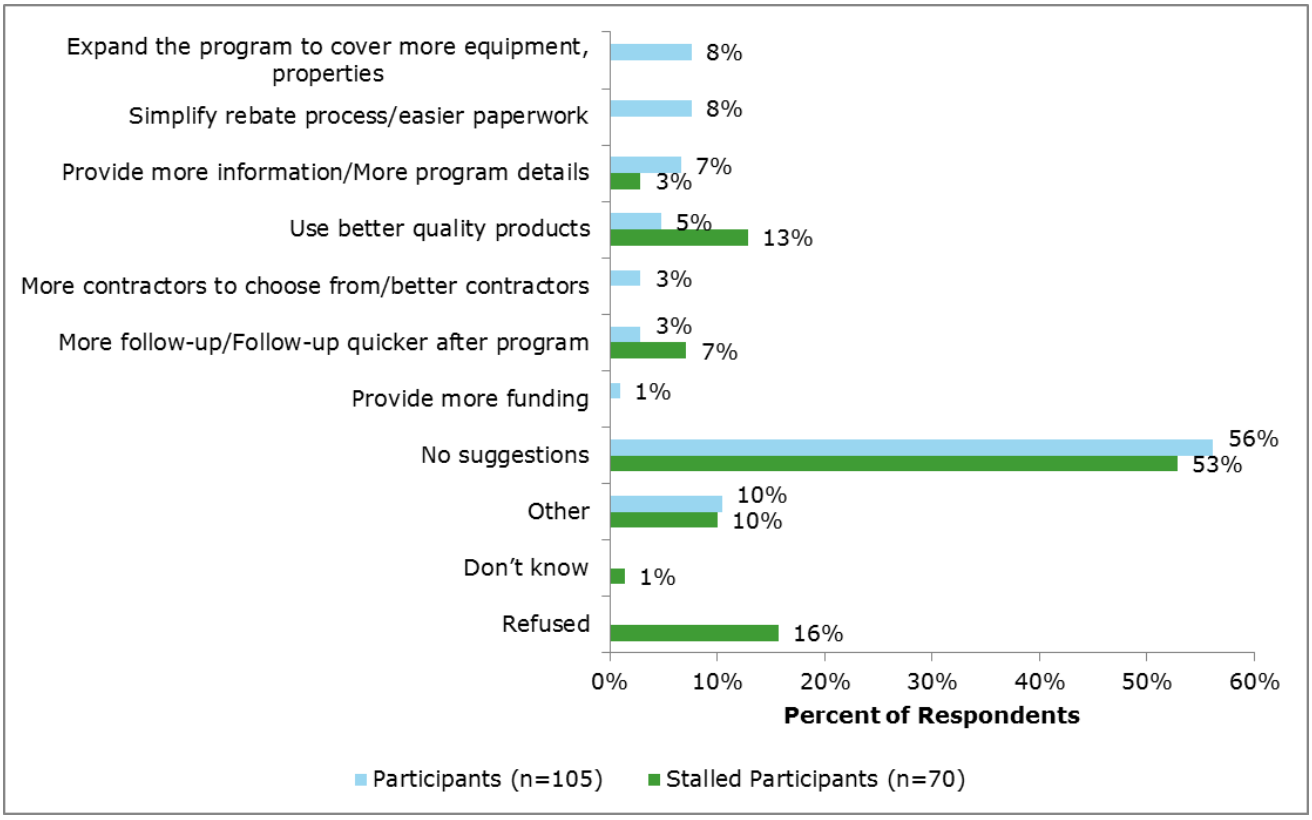

Figure 17: Suggestions for improving the program by participant group
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

3.3.5 Similarities between full and stalled participants

There were also some survey topics where there were *no* statistically significant differences between full participants and stalled participants. Such findings can be useful in helping to determine which barriers to full program participation may be less important. The following are some of these survey topics.

Finding the right decision-maker

One of the program actors we interviewed mentioned that difficulties in reaching the right decision-maker for a multifamily property can be a significant barrier to program recruitment. In our surveys of full participants and stalled participants we asked the respondents to identify their job titles. There were no statistically-significant differences between the full participants and the stalled participants in terms of the frequency with which they identified any particular job title. Since the full participants had a very similar mix of job titles as the stalled participants, this suggests that the more complete participation of the full participants was not because the program reached better decision-makers (or if they had, the better decision-makers were not identified in the program tracking database).

The split-incentive barrier

Theory suggests that when tenants pay their own utility bills, there is a greater chance of split-incentive barriers because landlords have no incentives to purchase energy-efficient equipment. When we asked both full participants and stalled participants whether tenants pay for their own utility bills, the percentage of tenants who pay their own bills was not different to a statistically-significant degree between the two groups. This suggests that the split-incentive barrier was not an explanatory factor as to why stalled participants did not progress further in the program

Recalling the audit

The survey asked the two participant groups whether they recalled receiving an energy audit. One might expect a higher percentage of stalled participants to not remember if they got an audit since they received services several years ago, while full participants received services in 2014. Yet the two groups had similar levels of recall for receiving an audit, with less than half recalling the audit. The stalled participants had a higher percentage of those who said they did not know if they got an audit, but it was not significantly higher. This lower level of audit recall by both stalled and full participants indicates a potential lack of awareness about the audit that occurs during this program. Other reasons could be that the person answering the survey was not the person onsite with the auditor and was not aware of exactly what happened during the visits. In either case, it does not seem that the audit itself made a significant impact on the decision to participate in the program.

Program satisfaction

When we compared average satisfaction ratings between full participants and stalled participants, the full participants were more satisfied than the stalled participants for only one of the six program activities. At first glance, this suggests that lack of satisfaction was not a significant reason why the stalled participants did not move further along in the program. Yet it is important to note that satisfaction with the overall program was the one satisfaction category where the full participants had a higher average satisfaction rating (to a statistically significant degree) than stalled participants. In addition, as discussed below, the average satisfaction rating metric, which removes the "don't know" and "not applicable" responses," probably does bias the satisfaction ratings somewhat since some of the lack of recall may be due to negative program outcomes (e.g., a program energy audit that was not very memorable).

4 RECOMMENDATIONS

Based on the key findings, recommendations collected directly from program participants and stalled participants, and DNV GL's overall assessment of the program, we offer the following recommendations:

Impact Evaluation Recommendations

Direct installation measures do not have 100% persistence. For planning purposes, including cost-effectiveness analysis, the program should assume that a proportion of measures directly installed by the program either fail or are removed by tenants before the end of their useful lives.

Assume an appropriate attrition rate for"plug" measures such as advanced power strip. Appliance and water fixture measures generally are left in place in tenant units, while measures that are plugged in can be easily removed by the property owner or tenant. The program may be able to use follow-up communications to address the issue where measures were left to the property manager and were never installed.

Combine program tracking database and project file data. Currently, the program tracking data is done at the site level while the project details, including where (i.e. tenant units) the measures are installed, are kept in separate disconnected files. Expanding the tracking database to include all of the relevant project level info would provide additional sample points for evaluations, allow for more reporting options, and ultimately help PSE better understand their program.

Process Evaluation Recommendations

The top suggestions which the full participants had for improving the program included expanding the program to cover more equipment or property types, simplifying the rebate process, providing more program information and using better quality products. There were several key process findings from the stalled participants that led to the following recommendations for program improvement:

The stalled participants have positive attitudes towards energy efficiency. The survey revealed that a large majority of the stalled participants thought that energy efficiency was important. This should allow the program to focus more on overcoming financial and other non-behavioral barriers to energy efficiency implementation.

The split-incentive barriers may not be as significant as they seem. Over half (60%) of the stalled participants reported that their decision making process for tenant areas and common areas was the same. The reduced importance of the split-incentive barrier among this stalled participant group should make it easier for the program to encourage action.

There may be opportunities to work with appliance supply contractors. Over a third (36%) of the stalled participants said they did have a contractor they used more frequently and nearly half (48%) of these mentioned HD Supply as their frequent contractor. When we asked the respondents what services they used these specific contractors for, they most frequently reported using them to get appliances (44%) and maintenance supplies (40%). If the program is not already working with HD Supply and other similar contractors, these survey results indicate that there is a real opportunity there for measures such as refrigerators.

There is need for more participant education on available rebates and other assistance. There was evidence from the stalled participant survey that more program information and assistance could have helped them move beyond the audit to project implementation. As noted above, 18% of the stalled participants said that they installed measures recommended by the program audit without seeking a rebate for these measures. When we asked them why they did not seek a rebate from PSE, their responses included not knowing about the rebates and believing they were ineligible for them. These responses indicate that the program could be doing more customer education in terms of drawing a stronger link between the audit recommendations and the program's rebate offerings.

Twenty-two percent of those stalled participants who recalled audit recommendations said additional information could have helped them implement some measures. The helpful information they mentioned included having someone come to give a bid for the work, getting back in touch with the implementers, a more detailed breakdown of what is available and the type of resources available to get it, and to receive more information on the measures.

The large majority of the stalled participant respondents only had very limited authority for project approval. Seventy-four percent of the stalled participant respondents said that they needed additional authorization over a certain dollar limit. Of those who needed additional authorization, the mean dollar amount they had authorization up to was $1,046 and the median was $500. This indicates that while the respondents were people involved in the program, they did not have sole authority to decide what equipment to install and how much of it to install. The authority generally rested with the owner (33%) or the regional manager (29%). This means that persuading the onsite manager may not be enough to get an energy efficiency project to move forward.

Many recent participants are not recalling the program rebates which could negatively impact program attribution. Forty percent of the full participants said they did not receive a rebate or incentive. This is surprising because their participation was relatively recent and so one would not expect many to have forgotten about the measures. This low level of full participant recall should be a concern for the program since it will reduce levels of program attribution (e.g., increase free ridership). It is possible that some of these full participants were unaware of the rebate because their contractors took the rebates and gave them line-item discounts instead, which is allowable under the current program. However, it is surprising that the contractors would receive the rebates this frequently. And even in these cases, one would assume that the contractors would still mention the discount as being program-influenced.

Email is the preferred means for providing program information. The survey asked the full participants about their preferred method of contact if PSE were to provide them with more information about rebates and other program services. The large majority (71%) of respondents cited email as their most preferred method of contact. The second and third most-cited preferences were in the mail, separate from the bill (28%) and as a bill insert (15%). It is not clear how frequently the program currently uses email to communicate program information but these findings indicate that there are opportunities to do more of these types of communications.

APPENDIX A. STALLED PARTICIPANT SURVEY GUIDE

PSE Multifamily Retrofit Program – Stalled Participant Survey

Introduction:

DM1. Hello this is <INTERVIEWER> calling on behalf of Puget Sound Energy, also known as PSE. May I please speak with <CUSTOMER NAME>?

[IF THEY ASK THE PURPOSE OF THE CALL] According to our records <CUSTOMER NAME> participated in a PSE program for increasing energy efficiency in multifamily buildings. This is a voluntary survey we are conducting on behalf of Puget Sound Energy to help them improve their energy-efficiency programs. PSE is seeking to improve the multifamily program and is seeking feedback on the program from former participants.

[**IF NECESSARY**:
We expect this survey to take around 15 minutes.

All information you provide will be kept confidential. Final results will be presented at an aggregated level.]

[PROGRAMMER NOTE: IF CONTACT=1, GO TO DM1, ELSE SKIP TO DM2]

[Contact available]	1	DM2
[Contact currently unavailable]	2	DM3
[Call Corporate Office]	3	RECORD NAME AND NUMBER
[Call Property Management Firm]	4	RECORD NAME AND NUMBER
[OTHER]	77	RECORD NAME AND NUMBER
[REFUSED]	98	TERMINATE

DM2. [REPEAT THIS INTRO IF RESPONDENT TO DM2 IS DIFFERENT THAN RESPONDENT TO DM1] Hello this is <INTERVIEWER> calling on behalf of Puget Sound Energy, also known as PSE.

According to our records, your company's multifamily property at <ADDRESS LIST> participated in a PSE program for increasing energy efficiency in multifamily buildings between 2010 and 2013.

Are you familiar with your organization's participation in this program? [IF NECESSARY, PROMPT: "You may remember a person coming to inspect the building for potential energy efficiency upgrades. You may have received some efficient light bulbs or showerheads.]

[Yes]	1	DM5
[No]	2	DM3
[REFUSED]	98	TERMINATE

DM3. Is there someone else at your organization who is familiar with your organization's participation in PSE's Multifamily Retrofit program?

[Yes]	1	RECORD FIRST_NAME2 and LAST_NAME2. GO TO DM4
[No]	2	TERMINATE
[REFUSED]	98	TERMINATE

DM4. Could I speak with <FIRST_NAME2> <LAST_NAME2> now?

[Yes]	1	CONNECT WITH PERSON AND GO BACK TO DM2
[No]	2	SCHEDULE CALL BACK TIME
[REFUSED]	98	END CALL (CALL BACK LATER)

DM5. Thank you. [RECORD NAME IF NAME NOT CONTACT]

[DON'T KNOW NAME] (ASK FOR NAME AND RECORD)	1	RECORD FIRST_NAME3 and LAST_NAME3. GO TO DM6
[<CONTACT_NAME>]	2	DM6
[<FIRST_NAME2> <LAST_NAME2>]	3	DM6
[REFUSED]	98	TERMINATE

DM6. Do you work onsite at one of the properties or in a corporate office?

[<property_name1>]	1
[<property_name2>]	2
[<property_name3>]	3
[Corporate office]	4
[Other, Specify_____]	77
[DON'T KNOW]	97
[REFUSED]	98

DM7. What is your job title?

[Record Response]	1
[REFUSED]	98

[PROGRAMMER NOTE: LOOP THROUGH DM8a-DM8c FOR EACH ADDRESS (CAPPED AT 3 DIFFERENT ADDRESSES)]

DM8a. Are the tenants at <ADDRESSx> responsible for paying their own utility bills, or are utilities included in the rent?

[Tenants pay their own bills]	1	DM8b
[Utilities included in the rent]	2	DM8b

[Tenants pay some utilities while others are included in rent]	3	DM8b
[Other – Specify]_____	77	DM8b
[DON'T KNOW]	97	DECISION-MAKING PROCESS
[REFUSED]	98	DECISION-MAKING PROCESS

DM8b. Is the electricity for the tenant units in this building individually metered or master-metered?

[Individually metered]	1
[Master metered]	2
[Other – Specify]_____	77
[DON'T KNOW]	97
[REFUSED]	98

DM8c. Is the natural gas for the tenant units in this building individually metered or master-metered?

[Individually metered]	1
[Master metered]	2
No Gas	3
[Other – Specify]_____	77
[DON'T KNOW]	97
[REFUSED]	98

Decision-making process

Before we discuss PSE's multifamily retrofit program, I'd like to ask a few questions about your organization's general decision-making process for purchasing or replacing energy-using equipment. Please answer all the following questions on behalf of your organization's decision-making process as a whole.

DECISION1. When you want to make improvements in the rental units or to the property itself, or when you purchase new equipment at that site, are you usually the only person involved in the decision or are others involved?

[Only person]	1
[Others involved]	2
[Depends on the situation]	3
[DON'T KNOW]	97
[REFUSED]	98

DECISION2a. When you are making purchase decisions for your property, do you need additional authorization for expenditures over a certain dollar limit?

[Yes]	1	DECISION2b
[No]	2	DECISION3a
[DON'T KNOW]	97	DECISION3a
[REFUSED]	98	DECISION3a

DECISION2b. What is that dollar limit?

[Record answer] _____ _____	1	[DON'T KNOW]	97
		[REFUSED]	98

DECISION2c. Who has the authority to authorize purchases above that dollar limit? PROBE AS NECESSARY: What is their job title?

[Record name(s) and job title(s)] _____ _____	1	[DON'T KNOW]	97
		[REFUSED]	98

DECISION3a. In general, when upgrading or replacing energy-using equipment in your common areas or tenant units, what **sources of information** do you use to help make a decision? [DO NOT READ. SELECT ALL THAT APPLY]

[Contractor recommendation]	1	[Other - SPECIFY] _____	77
[PSE/utility website]	2	[DON'T KNOW]	97
[Online research]	3	[REFUSED]	98
[Ask a colleague or a friend]	4		

DECISION3b. In general, when upgrading or replacing energy-using equipment in your common areas or tenant units, what factors does your organization consider?

[Record answer] _____ _____	1	[DON'T KNOW]	97
		[REFUSED]	98

DECISION4a. On a scale of 1 to 5, where one is very unimportant and 5 is very important, how important is the energy efficiency of the equipment when you are thinking of upgrading or replacing energy-using equipment and other building improvements?

1 – Very unimportant	1	DECISION4b
2	2	DECISION4b
3	3	DECISION4b
4	4	DECISION4b
5 – Very important	5	DECISION4b
[DON'T KNOW]	97	DECISION5a
[REFUSED]	98	DECISION5a

DECISION4b. Why do you say that?

[Record answer] _____ _____	1	[DON'T KNOW]	97
		[REFUSED]	98

DECISION5a. In general, when considering upgrading or replacing energy-using equipment and other building improvements, do you consider some of the non-energy characteristics of energy-efficient equipment, such as reduced maintenance costs for light bulbs or lamps with longer lives?

[Yes]	1	DECISION6
[No]	2	DECISION6
[DON'T KNOW]	97	DECISION6
[REFUSED]	98	DECISION6

DECISION6. How does your decision making process differ for upgrades of energy-using equipment in common areas versus tenant areas?

[Record answer] _____ _____	1	[DON'T KNOW]	97
		[REFUSED]	98

DECISION7a. Are there any particular contractors who you use more frequently for equipment maintenance, upgrades, or replacement?

[Yes]	1	DECISION7b
[No]	2	REVIEW OF SERVICES RECEIVED
[DON'T KNOW]	97	REVIEW OF SERVICES RECEIVED
[REFUSED]	98	REVIEW OF SERVICES RECEIVED

DECISION7b. Which contractors do you use regularly? [FOR EACH CONTRACTOR PROMPT:] "What kind of work do you use that contractor for?"

[Record name of contractors and what kind of work they do] _____ _____	1	[DON'T KNOW]	97
		[REFUSED]	98

Review of services received

SERVICES1. Now I'd like to discuss PSE's multifamily retrofit program. You may remember a person coming to inspect the building for potential energy efficiency upgrades. You may have received some efficient light bulbs or showerheads. Do you recall participating in this program?

[Yes]	1	SERVICES2
[No]	2	SERVICES2
[DON'T KNOW]	97	SERVICES2
[REFUSED]	98	SERVICES2

SERVICES2. I'd like to know what kind of aid or assistance you recall receiving from the program? Did you receive…? [ASK EACH INDIVIDUALLY AND GET A RESPONSE FOR EACH]

		Yes	No	[DON'T KNOW]	[REFUSED]
a	An energy audit	1	2	97	98
b	Directly installed energy efficiency measures such as CFLs or showerheads	1	2	97	98
c	Suggestions for energy efficiency improvements	1	2	97	98
d	Rebates or incentives for energy efficiency improvements	1	2	97	98
e	Assistance in finding contractors to install these energy-efficient measures	1	2	97	98
f	Something else (Specify)_____	1	2	97	98

SERVICES3. Do you recall any of the energy-efficiency improvements recommended in the audit report?

[Yes]	1	SERVICES4a
[No]	2	SERVICES12a
[REFUSED]	98	SERVICES12a

SERVICES4a. Since receiving your energy audit from the PSE multifamily retrofit program, have you implemented any energy-efficient improvements recommended by the audit at <ADDRESS1> or <ADDRESS2> or <ADDRESS3>? Please do not include items received on the day of the audit, such as CFLs and showerheads.

[Yes]	1	SERVICES4b
[No]	2	SERVICES4f
[DON'T KNOW]	97	SERVICES5a
[REFUSED]	98	SERVICES5a

SERVICES4b. Which measures have you installed? [DO NOT READ. SELECT ALL THAT APPLY]

EE Measure	Code	EE Measure	Code
[In-unit clothes washer]	1	[Electric to natural gas water heat fuel conversion]	13
[Windows and sliding glass doors]	2	[In-unit furnace]	14
[In-unit water heater]	3	[In-unit fireplace]	15
[In-unit refrigerator]	4	[In-unit boiler]	16
[Refrigerator recycling]	5	[In-unit integrated space and water heating boiler]	17
[Whole house ventilation system]	6	[Other (Specify)]_____	77
[Attic, floor, and wall insulation]	7	[DON'T KNOW]	97
[CFL fixtures]	8	[REFUSED]	98
[LED fixtures]	9		
[Fluorescent fixtures]	10		
[Heat pump water heater]	11		
[Common area lighting]	12		

SERVICES4c. Do you recall receiving a rebate from PSE for any of these measures?

[Yes]	1	SERVICES4d
[No]	2	SERVICES4e
[DON'T KNOW]	97	SERVICES5a
[REFUSED]	98	SERVICES5a

SERVICES4d Which measures do you recall receiving a rebate for? [DO NOT READ. SELECT ALL THAT APPLY]

EE Measure	Code	EE Measure	Code
[In-unit clothes washer]	1	[Electric to natural gas water heat fuel conversion]	13
[Windows and sliding glass doors]	2	[In-unit furnace]	14
[In-unit water heater]	3	[In-unit fireplace]	15
[In-unit refrigerator]	4	[In-unit boiler]	16
[Refrigerator recycling]	5	[In-unit integrated space and water heating boiler]	17
[Whole house ventilation system]	6	[Other (Specify)]_____	77
[Attic, floor, and wall insulation]	7	[DON'T KNOW]	97
[CFL fixtures]	8		
[LED fixtures]	9	[REFUSED]	98
[Fluorescent fixtures]	10		
[Heat pump water heater]	11		
[Common area lighting]	12		

[PROGRAMMER NOTE: ASK ONLY IF SERVICES4c=2 "No", ELSE SKIP TO SERVICES5a]
SERVICES4e. Why didn't you seek a rebate from PSE for these measures? [RECORD ALL THAT APPLY]

[Too much paperwork]	1
[I was ineligible for that rebate]	2
[Did seek one, but never received]	3
[I was too busy]	4
[The rebates were not large enough]	5
Other (Specify_____)	77
[DON'T KNOW]	97
[REFUSED]	98

[PROGRAMMER NOTE: ASK ONLY IF SERVICES4a=2 "No", ELSE SKIP TO SERVICES5a]

SERVICES4f. Why weren't the recommended measures installed? [DO NOT READ. SELECT ALL THAT APPLY]

[Financial limitations]	1	[Fuel prices were low]	10
[Already did all cost-effective energy efficiency improvements]	2	[New to building]	11
[Unaware of/unable to identify measures]	3	[Timing]	12
[Tenants pay their own utility bills]	4	[Technology unavailable]	13
[Lack of maintenance staff to install measures]	5	[Replacing on an as-needed basis]	14
[Lack of time/not a priority]	6	[It was unnecessary]	15
[Question reliability of energy efficient equipment]	7	Anything Else [Other - SPECIFY] _____	77
[Lack of information on energy savings or costs]	8	[DON'T KNOW]	97
[Energy savings estimates for equipment are unreliable]	9	[REFUSED]	98

SERVICES5a. Do you plan to install any audit recommendations that you have not gotten to yet?

[Yes]	1	SERVICES5b
[No]	2	SERVICES6a
[DON'T KNOW]	97	SERVICES6a
[REFUSED]	98	SERVICES6a

SERVICES5b. Which measures do you plan to install?

EE Measure	Code	EE Measure	Code
[In-unit clothes washer]	1	[Electric to natural gas water heat fuel conversion]	13
[Windows and sliding glass doors]	2	[In-unit furnace]	14
[In-unit water heater]	3	[In-unit fireplace]	15
[In-unit refrigerator]	4	[In-unit boiler]	16
[Refrigerator recycling]	5	[In-unit integrated space and water heating boiler]	17
[Whole house ventilation system]	6	[Other (Specify)]_____	77
[Attic, floor, and wall insulation]	7	[DON'T KNOW]	97
[CFL fixtures]	8	[REFUSED]	98
[LED fixtures]	9		
[Fluorescent fixtures]	10		
[Heat pump water heater]	11		
[Common area lighting]	12		

SERVICES6a. Are there any energy-efficient measures recommended by the PSE program audit that you do not plan to install?

[Yes]	1	SERVICES6b
[No]	2	SERVICES7
[DON'T KNOW]	97	SERVICES7
[REFUSED]	98	SERVICES7

SERVICES6b. Which measures do you not plan to install?

EE Measure	**Code**	**EE Measure**	**Code**
[In-unit clothes washer]	1	[Common area lighting]	**12**
[Windows and sliding glass doors]	2	[Electric to natural gas water heat fuel conversion]	**13**
[In-unit water heater]	3	[In-unit furnace]	**14**
[In-unit refrigerator]	4	[In-unit fireplace]	**15**
[Refrigerator recycling]	5	[In-unit boiler]	**16**
[Whole house ventilation system]	6	[In-unit integrated space and water heating boiler]	**17**
[Attic, floor, and wall insulation]	7	[Other (Specify)]_____	**77**
[CFL fixtures]	8	[DON'T KNOW]	97
[LED fixtures]	9	[REFUSED]	98
[Fluorescent fixtures]	10		
[Heat pump water heater]	11		

SERVICES6c. Why are there no plans to install these recommended measures? [DO NOT READ. SELECT ALL THAT APPLY]

[Financial limitations]	1	[Fuel prices were low]	10
[Already did all cost-effective energy efficiency improvements]	2	[New to building]	11
[Unaware of/unable to identify measures]	3	[Timing]	12
[Tenants pay their own utility bills]	4	[Technology unavailable]	13
[Lack of maintenance staff to install measures]	5	[Replacing on an as-needed basis]	14
[Lack of time/not a priority]	6	[It was unnecessary]	15
[Question reliability of energy efficient equipment]	7	Anything Else [Other - SPECIFY] _____	77
[Lack of information on energy savings or costs]	8	[DON'T KNOW]	97
[Energy savings estimates for equipment are unreliable]	9	[REFUSED]	98

SERVICES7 – [ASK ONLY IF DM8a=1]. Earlier you said your tenants pay their own utility bills. On a scale of 1 to 5, where 1 is very unimportant and 5 is very important, how important was this as a reason why you did not make these energy efficient improvements?

1 - Very unimportant	1
2	2
3	3
4	4
5 – Very important	5
[Did all improvements recommended]	96
[DON'T KNOW]	97
[REFUSED]	98

SERVICES8a. Is there any additional information that would help you implement these measures?

Yes	1	SERVICES8b
No	2	SERVICES9a
[DON'T KNOW]	97	SERVICES9a
[REFUSED]	98	SERVICES9a

SERVICES8b. What information would help you implement these measures?

[Record Response]	1
[DON'T KNOW]	97
[REFUSED]	98

SERVICES9a. Is there any financial support you need in order to implement these recommended measures?

Yes	1	SERVICES9b
No	2	SERVICES10a
[DON'T KNOW]	97	SERVICES10a
[REFUSED]	98	SERVICES10a

SERVICES9b. What types of financial support would help you implement these measures?

[Record Response]	1
[DON'T KNOW]	97
[REFUSED]	98

SERVICES10a. On a scale of 1 to 5, where one is very uninterested and five is very interested, how interested would you be if PSE were to offer a low-interest loan for these measures?

1 - Very uninterested	1	SERVICES10b
2	2	SERVICES10b
3	3	SERVICES10b
4	4	SERVICES10b
5 - Very interested	5	SERVICES10b
[Not the decision maker]	96	CUSTOMER SATISFACTION
[DON'T KNOW]	97	CUSTOMER SATISFACTION
[REFUSED]	98	CUSTOMER SATISFACTION

SERVICES10b. Why do you give that score?

[Record Response]	1
[DON'T KNOW]	97
[REFUSED]	98

SERVICES11a. Are there any energy efficiency measures you installed recently at this building that were not recommended by the program audit?

[Yes]	1	SERVICES11b
[No]	2	CUSTOMER SATISFACTION

[DON'T KNOW]	97	CUSTOMER SATISFACTION
[REFUSED]	98	CUSTOMER SATISFACTION

SERVICES11b. Which measures were they?

[Record answer] _____ _____	1	[DON'T KNOW]	97
		[REFUSED]	98

SERVICES11c. Did you receive a rebate for all or some of these measures?

[Yes – all of them]	1	CUSTOMER SATISFACTION
[Yes – some of them]	2	SERVICES11d
[No]	3	SERVICES11d
[DON'T KNOW]	97	CUSTOMER SATISFACTION
[REFUSED]	98	CUSTOMER SATISFACTION

SERVICES11d. Why didn't you go through the program for all of these measures?

[Rebate wasn't offered for that measure]	1	Anything Else [Other - SPECIFY] _____	77
[Too much effort to get the incentive]	2	[DON'T KNOW]	97
[Lack of time]	3	[REFUSED]	98
[Didn't know I could get a rebate for that measure]	4		

[PROGRAMMING NOTE: ASK ONLY IF SERVICES3=2 "No", ELSE SKIP TO CUSTOMER SATISFACTION]

SERVICES12a. Are there any energy efficiency measures you installed recently?

[Yes]	1	SERVICES12b
[No]	2	CUSTOMER SATISFACTION
[DON'T KNOW]	97	CUSTOMER SATISFACTION
[REFUSED]	98	CUSTOMER SATISFACTION

SERVICES12b. Which measures were they?

[Record answer] _____ _____	1	[DON'T KNOW]	97
		[REFUSED]	98

SERVICES12c. Did you receive a rebate for all or some of these measures?

[Yes – all of them]	1	CUSTOMER SATISFACTION
[Yes – some of them]	2	SERVICES12d
[No – none of them]	3	SERVICES12d
[DON'T KNOW]	97	CUSTOMER SATISFACTION
[REFUSED]	98	CUSTOMER SATISFACTION

SERVICES12d. Why didn't you go through the program for all of these measures?

[Rebate wasn't offered for that measure]	1	Anything Else [Other - SPECIFY] _____	77
[Too much effort to get the incentive]	2	[DON'T KNOW]	97
[Lack of time]	3	[REFUSED]	98
[Didn't know I could get a rebate for that measure]	4		

Customer satisfaction

Next I have a few questions about how satisfied you were with different aspects of this program for the services done at <ADDRESS LIST>.

SATIS1. For each of the following program components, please tell me how satisfied or dissatisfied you were, using a scale from one to five, where one is very dissatisfied and five is very satisfied.
ROTATE ATTRIBUTES A-G. ANCHOR H, ALWAYS ASKING LAST

		Very dissatisfied				Very satisfied	[DON'T KNOW]	[REFUSED]	Not Applicable
a	The information about the program	1	2	3	4	5	97	98	99
b	The energy audit	1	2	3	4	5	97	98	99
c	The direct install measures	1	2	3	4	5	97	98	99
d	The contractor who did the direct install measures on the same day as the audit	1	2	3	4	5	97	98	99
e	The audit report with suggested measures	1	2	3	4	5	97	98	99
f	The program website	1	2	3	4	5	97	98	99
g	The program staff	1	2	3	4	5	97	98	99
h	Your overall experience with the multifamily program	1	2	3	4	5	97	98	99

SATIS2a - [ONLY ASK IF SATIS1a ≤ 3] Why were you less than satisfied with the information about the program? [DO NOT READ. SELECT ALL THAT APPLY]

[Didn't know where to find it]	1	[No reason]	78
[Didn't understand the information I received]	2	[DON'T KNOW]	97
[Other - SPECIFY] _____	77	[REFUSED]	98

SATIS2b - [ONLY ASK IF SATIS1b ≤ 3] Why were you less than satisfied with the energy audit? [DO NOT READ. SELECT ALL THAT APPLY]

[Audit was difficult to schedule]	1	[I didn't get any free equipment]	6
[Auditor showed up late]	2	[Other - SPECIFY] _____	77
[Audit took too long]	3	[No reason]	78
[Auditors were unprofessional/discourteous]	4	[DON'T KNOW]	97
[Audit didn't teach me anything new]	5	[REFUSED]	98

SATIS2c - [ONLY ASK IF SATIS1c ≤ 3] Why were you less than satisfied with the direct install measures? [DO NOT READ. SELECT ALL THAT APPLY]

[Didn't get any]	1	[Other - SPECIFY] _____	77
[Didn't save energy with them]	2	[No reason]	78
[They are worse than my old measures]	3	[DON'T KNOW]	97
[They broke/burned out/were low quality]	4	[REFUSED]	98

SATIS2d - [ONLY ASK IF SATIS1d ≤ 3] Why were you less than satisfied with the contractor who did the direct install measures during the audit? [DO NOT READ. SELECT ALL THAT APPLY]

[Contractor showed up late]	1	[Other - SPECIFY] _____	77
[Contractor broke something]	2	[No reason]	78
[Contractor was unprofessional/discourteous]	3	[DON'T KNOW]	97
[Contractor was messy/disruptive]	4	[REFUSED]	98

SATIS2e - [ONLY ASK IF SATIS1e ≤ 3] Why were you less than satisfied with the audit report with suggested measures? [DO NOT READ. SELECT ALL THAT APPLY]

[Didn't get any suggestions that I wasn't already aware of]	1	[No reason]	78
[The report didn't have the measures I wanted to do]	2	[DON'T KNOW]	97
[Wanted more info about next steps, e.g. finding contractors]	3	[REFUSED]	98
[Other - SPECIFY] _____	77		

SATIS2f - [ONLY ASK IF SATIS1f ≤ 3] Why were you less than satisfied with the program website? [DO NOT READ. SELECT ALL THAT APPLY]

[I couldn't find what I was looking for]	1	[Other - SPECIFY] _____	77
[The layout was confusing]	2	[No reason]	78
[It took too long to find what I was looking for]	3	[DON'T KNOW]	97
[The information wasn't helpful]	4	[REFUSED]	98

SATIS2g - [ONLY ASK IF SATIS1g ≤ 3] Why were you less than satisfied with the program staff? [DO NOT READ. SELECT ALL THAT APPLY]

[They weren't responsive to questions/concerns]	1	[Other - SPECIFY] _____	77
[They were not courteous/they were rude]	2	[No reason]	78
[The information wasn't helpful]	3	[DON'T KNOW]	97
		[REFUSED]	98

SATIS2h - [ONLY ASK IF SATIS1h ≤ 3] Why were you less than satisfied with the program overall? [DO NOT READ. SELECT ALL THAT APPLY]

[Not pleased with performance of the equipment]	1	[Other - SPECIFY] _____	77
[Not pleased with energy savings]	2	[No reason]	78
[Not pleased with the contractor]	3	[DON'T KNOW]	97
[Aesthetics-- system does not look good etc.]	4	[REFUSED]	98

SATIS3 What suggestions do you have for improving the program?

[Record answer] _____ _____	1	[No suggestions]	2
		[DON'T KNOW]	97
		[REFUSED]	98

Firmographics

Finally, I'd like to ask some questions about your company's structure and the characteristics of <ADDRESS LIST> that we've been discussing. This information won't be shared to any third parties and is only used in the aggregate level to characterize the results.

FIRM1a. Where is your company headquartered?

[RECORD RESPONSE]	1
[DON'T KNOW]	97
[REFUSED]	98

FIRM2. Does your company own or rent the properties that you manage?

Own	1
Rent	2
[Both own and rent]	3
[Other – Specify _____]	77
[DON'T KNOW]	97
[REFUSED]	98

FIRM3. How many properties does your company own or manage?

[Record Number]	1
[DON'T KNOW]	97
[REFUSED]	98

[PROGRAMMER NOTE: LOOP THROUGH FIRM4-FIRM9 FOR EACH ADDRESS]

FIRM4. Is the property at <ADDRESSx> an apartment building, a condominium, or something else?

Apartment building	1
Condominium	2
Other (Specify_____)	77
[DON'T KNOW]	97
[REFUSED]	98

FIRM5. When was this property built? [IF DOESN'T KNOW EXACT YEAR, PROMPT FOR ONE OF THE PRE-CODED OPTIONS]

[Record Year Built]	1
Before 1940	2
1940 to 1949	3
1950 to 1959	4
1960 to 1969	5
1970 to 1979	6
1980 to 1989	7
1990 to 1999	8
2000 to 2009	9
2010 to present	10
[DON'T KNOW]	97
[REFUSED]	98

FIRM6. How many tenant units are there in this facility at <ADDRESSx>?

[Record Number]	1
[DON'T KNOW]	97
[REFUSED]	98

FIRM7. When thinking about the income levels of the tenants at this property, which of the following characterizes the property best: mostly low income; mostly middle income; mostly upper income; somewhat diverse, with low and middle income tenants; somewhat diverse with middle and upper income tenants; or very diverse with low, middle, and upper income tenants?

Mostly low income	1
Mostly middle income	2
Mostly high income	3
Somewhat diverse, with low and middle income tenants	4
Somewhat diverse with middle and upper income tenants	5
Very diverse with low, middle, and upper income tenants	6
[DON'T KNOW]	97
[REFUSED]	98

FIRM8. Does this property have a centralized heating system or individual units?

Centralized	1
Individual	2
[DON'T KNOW]	97
[REFUSED]	98

FIRM9. Does this property have a centralized cooling system or individual units?

Centralized	1
Individual	2
No Cooling system	3
[DON'T KNOW]	97
[REFUSED]	98

END

That concludes our survey. We appreciate your input for this survey. Thank you for your time.

APPENDIX B. PARTICIPANT SURVEY GUIDE

PSE Multifamily Retrofit Program Survey

Introduction:

DM1. Hello this is <INTERVIEWER> calling on behalf of Puget Sound Energy, also known as PSE. May I please speak with <CUSTOMER NAME>?

[IF THEY ASK THE PURPOSE OF THE CALL] According to our records <CUSTOMER NAME> participated in a PSE program for increasing energy efficiency in multifamily buildings. This is a voluntary survey we are conducting on behalf of Puget Sound Energy to help them improve their energy-efficiency programs. PSE is seeking to improve the multifamily program and is seeking feedback on the program from former participants.

[**IF NECESSARY**:
We expect this survey to take about 15 to 20 minutes.

All information you provide will be kept confidential. Final results will be presented at an aggregated level.]
[PROGRAMMER NOTE: IF CONTACT=1, GO TO DM1, ELSE SKIP TO DM2]

[Contact available]	1	DM2
[Contact currently unavailable]	2	DM3
[Call Corporate Office]	3	RECORD NAME AND NUMBER
[Call Property Management Firm]	4	RECORD NAME AND NUMBER
[OTHER]	77	RECORD NAME AND NUMBER
[REFUSED]	98	TERMINATE

DM2. [REPEAT THIS INTRO IF RESPONDENT TO DM2 IS DIFFERENT THAN RESPONDENT TO DM1] Hello this is <INTERVIEWER> calling on behalf of Puget Sound Energy, also known as PSE.

According to our records, in 2014, your company participated in a PSE program for increasing energy efficiency in multifamily buildings.

Are you familiar with your organization's participation in this program in 2014? [IF NECESSARY, PROMPT: "You may remember a person coming to inspect the building for potential energy efficiency upgrades. You may have received some efficient light bulbs or showerheads.]

[Yes]	1	DM5
[No]	2	DM3
[REFUSED]	98	TERMINATE

DM3. Is there someone else at your organization who is familiar with your organization's participation in PSE's Multifamily Retrofit program?

[Yes]	1	RECORD FIRST_NAME2 and LAST_NAME2. GO TO DM4
[No]	2	TERMINATE
[REFUSED]	98	TERMINATE

DM4. Could I speak with <FIRST_NAME2> <LAST_NAME2> now?

[Yes]	1	CONNECT WITH PERSON AND GO BACK TO DM2
[No]	2	SCHEDULE CALL BACK TIME
[REFUSED]	98	END CALL (CALL BACK LATER)

DM5. Thank you. [RECORD NAME IF NAME NOT CONTACT]

[DON'T KNOW NAME] (ASK FOR NAME AND RECORD)	1	RECORD FIRST_NAME3 and LAST_NAME3. GO TO DM6
[<CONTACT_NAME>]	2	DM6
[<FIRST_NAME2> <LAST_NAME2>]	3	DM6
[REFUSED]	98	TERMINATE

[IF HAS MORE THAN 1 PROPERTY THEN ASK]
DM5b. Are you familiar with the work done at

	Yes	No	Don't know	Refused
[<property_name1>]	1	2	97	98
[<property_name2>]	1	2	97	98
[<property_name3>]	1	2	97	98

[PROGRAMMER NOTE: If respondent does not know about property DM5b=2,97,98, then drop that property from the future questions]

DM6. Do you work onsite at one of the properties or in a corporate office? [PROBE: IF SAY THEY DO NOT WORK HERE, THEY LIVE HERE, ASK IF THEY OWN THE CONDO THEY LIVE IN. SELECT OPTION 5]

[<property_name1>]	1	DM7
[<property_name2>]	2	DM7
[<property_name3>]	3	DM7
[Corporate office]	4	DM7
[Does not work for the building, owns the condo]	5	SERVICES1
[Other, Specify_____]	77	DM7
[DON'T KNOW]	97	DM7
[REFUSED]	98	DM7

DM7. What is your job title?

[Record Response]	1
[REFUSED]	98

[PROGRAMMER NOTE: LOOP THROUGH DM8a-DM8c FOR EACH ADDRESS (CAPPED AT 3 DIFFERENT ADDRESSES)]

DM8a. Are the tenants at <ADDRESSx> responsible for paying their own utility bills, or are utilities included in the rent?

[Tenants pay their own bills]	1	DM8b
[Utilities included in the rent]	2	DM8b
[Tenants pay some utilities while others are included in rent]	3	DM8b
[Other – Specify]_____	77	DM8b
[DON'T KNOW]	97	SERVICES1
[REFUSED]	98	SERVICES1

DM8b. Is the electricity for the tenant units in this building individually metered or master-metered?

[Individually metered]	1
[Master metered]	2
[Other – Specify]_____	77
[DON'T KNOW]	97
[REFUSED]	98

DM8c. Is the natural gas for the tenant units in this building individually metered or master-metered?

[Individually metered]	1
[Master metered]	2
[No gas]	3
[Other – Specify]_____	77
[DON'T KNOW]	97
[REFUSED]	98

Review of services received

[IF DM6 NOT EQUAL TO 5 THEN INSERT "Please answer the following questions on behalf of your property or organization."]

SERVICES1. I'd like to know what kind of aid or assistance you received from the program? Did you receive…? [ASK EACH INDIVIDUALLY AND GET A RESPONSE FOR EACH]

		Yes	No	Don't know	Refused	Not applicable
a	An energy audit	1	2	97	98	99

b	Directly installed energy efficiency measures such as CFLs or faucet aerators	1	2	97	98	99
c	Suggestions for energy efficiency improvements	1	2	97	98	99
d	Rebates or incentives for energy efficiency improvements	1	2	97	98	99
e	Assistance in finding contractors to install these energy-efficient measures	1	2	97	98	99
f	Something else (Specify)_____	1	2	97	98	99

Awareness

Now we would like to find out how you first became aware of this program.

AWARE1. How did you hear about the Multifamily Retrofit Program? [DO NOT READ. RECORD ALL THAT APPLY]

[A contractor contacted me]	1	[Advertisements other than utility website or bill insert, online or printed]	9
[From my contractor/a contractor I've used before]	2	[Radio, TV ads]	10
[PSE/utility website]	3	[A colleague within my organization recommended it]	11
[Bill Insert, Information included with utility bill]	4	[Previously participated in this program]	12
[Word of mouth]	5	[Other - SPECIFY] _____	77
[Participation in another PSE program]	6	[Don't know]	97
[From a condo association]	7	[Refused]	98
[At a trade show]	8		

AWARE2. If the program wanted to send you information about rebates and other program services, what would be your preferred way of receiving this information? [DO NOT READ. RECORD ALL THAT APPLY]

[Bill Insert, Information included with utility bill]	1	[Prefer they don't send me information]	5
[In the mail, separate from my bill]	2	[Other - SPECIFY] _____	77
[Email]	3	[Don't know]	97
[Phone]	4	[Refused]	98

AWARE3. How did you hear about the contractor(s) who installed the <Measures> through this program? [DO NOT READ. RECORD ALL THAT APPLY]

[A contractor contacted me]	1	[Saw truck and called]	8
[From my contractor/a contractor I've used before]	2	[The first one who called me back]	9
[PSE's Contractor Alliance Network]	3	[Installed by on-site staff]	10
[Word of mouth]	4	[Other - SPECIFY] _____	77
[Yellow pages or online search engine]	5	[Don't know]	97
[Local newspaper advertisements]	6	[Refused]	98
[Online advertisements]	7		

AWARE4. You installed <MEASURES> through PSE's multifamily retrofit program. Before now were you aware that this program also provides rebates for other types of energy efficient equipment for apartment buildings?

[Yes]	1	AWARE5
[No]	2	REASON1
[Don't know]	97	REASON1
[Refused]	98	REASON1

AWARE5. What other types of energy-efficient measures were you aware of that qualify for rebates from this program? [DO NOT READ. SELECT ALL THAT APPLY]

EE Measure	**Code**	**EE Measure**	**Code**
[In-unit clothes washer]	1	[Electric to natural gas water heat fuel conversion]	12
[Windows and sliding glass doors]	2	[In-unit furnace]	13
[In-unit water heater]	3	[In-unit fireplace]	14
[In-unit refrigerator]	4	[In-unit boiler]	15
[Refrigerator recycling]	5	[In-unit integrated space and water heating boiler]	16
[Whole house ventilation system]	6	[Other (Specify)]_____	77
[Attic, floor, and wall insulation]	7	[Don't know]	97
[LED fixtures]	8	[Refused]	98
[Fluorescent fixtures]	9		
[Heat pump water heater]	10		
[Common area lighting]	11		

AWARE6. Why haven't you chosen to take advantage of these rebates? [DO NOT READ. SELECT ALL THAT APPLY]

[Financial limitations]	1	[Fuel prices were low]	10
[Already did all cost-effective energy efficiency improvements]	2	[New to building]	11
[Unaware of/unable to identify	3	[Timing]	12

measures]			
[Tenants pay their own utility bills]	4	[Technology unavailable]	13
[Lack of maintenance staff to install measures]	5	[Replacing on an as-needed basis]	14
[Lack of time/not a priority]	6	[It was unnecessary]	15
[Question reliability of energy efficient equipment]	7	Anything Else [Other - SPECIFY] _____	77
[Lack of information on energy savings or costs]	8	[Don't know]	97
[Energy savings estimates for equipment are unreliable]	9	[Refused]	98

Reasons

Next, we would like to understand how you decided to participate in this program.

REASON1. In general, when purchasing or replacing energy-using equipment, what sources of information do you use to help you make a decision? [DO NOT READ. SELECT ALL THAT APPLY]

[Contractor recommendation]	1	Source within our own company/organization]	6
[PSE/utility website]	2	[Other - SPECIFY] _____	77
[Online research]	3	[Don't know]	97
[Ask a colleague or a friend]	4	[Refused]	98
[Trade shows]	5		

REASON2. What were your reasons for participating in **this** program? [DO NOT READ. SELECT ALL THAT APPLY]

[Reducing utility bills/ Saving energy]	1	[Contractor recommendation]	8
[Environmental reasons/ Making the building more green]	2	[Payback]	9
[Rebate offering]	3	[Introduced through other PSE programs]	10
[Get free audit/measures]	4	[Other - SPECIFY] _____	77
[Equipment upgrade]	5	[Don't know]	97
[Equipment failure]	6	[Refused]	98
[Doing major retrofit of building]	7		

REASON3. What barriers, if any, did you have to overcome to participate in this program? [Prompt: By barriers, we mean anything that might have prevented you from participating in this program.]

[Record answer] _____ _____ _____	1	[No barriers]	2
		[Don't know]	97
		[Refused]	98

Program influence

We would now like to discuss the influence, if any, the PSE multifamily retrofit program had on your decisions to install the equipment.

[PROGRAMMER NOTE: REPEAT THIS SECTION FOR EACH PROPERTY]

FR0. Who came up with the idea for the energy efficiency improvements at < ADDRESSx>? Was it mainly your idea, mainly the contractor's idea, mainly from the program energy audit, or some combination of these? [IF COMBINATION, PROBE FOR WHICH COMBINATION OF PROJECT IDEAS SOURCES]?

Mainly respondent's idea	1
Mainly contractor's idea	2
Mainly from the program energy audit	3
Combination/other (Specify)_____	77
[Don't know]	97
[Refused]	98

FR1. Did the PSE Multifamily Retrofit program help your organization identify energy efficiency opportunities your organization was previously unaware of?

[Yes]	1
[No]	2
[Don't know]	97
[Refused]	98

FR2. Did the program help your organization with the measure installation process, such as helping find the appropriate contractor?

[Yes]	1
[No]	2
[NA – did not need a contractor for the install]	96
[Don't know]	97
[Refused]	98

Now we will go through some questions about each measure type installed.

[PROGRAMMING NOTE: REPEAT FR3a-FR3b FOR EACH MEASURE INSTALLED]

FR3a. Before your organization installed the < Measure_Group_x_Description> at < ADDRESSx> in <PROJECT YEAR>, had you installed the < Measure_Group_x_Description> technology at this location or any of the other properties that you manage or own?

[Yes]	1	FR4
[No]	2	FR3b
[Don't know]	97	FR4
[Refused]	98	FR4

FR3b. Why hadn't you installed the < Measure_Group_x_Description> before participating in the PSE multifamily retrofit program? [DO NOT READ. RECORD ALL THAT APPLY]

[Financial limitations]	1	[Fuel prices were low]	10
[Already did all cost-effective energy efficiency improvements]	2	[New to building]	11
[Unaware of/unable to identify measures]	3	[Timing]	12
[Tenants pay their own utility bills]	4	[Technology unavailable]	13
[Lack of maintenance staff to install measures]	5	[Replacing on an as-needed basis]	14
[Lack of time/not a priority]	6	[It was unnecessary]	15
[Question reliability of energy efficient equipment]	7	Anything Else [Other - SPECIFY] _____	77
[Lack of information on energy savings or costs]	8	[Don't know]	97
[Energy savings estimates for equipment are unreliable]	9	[Refused]	98

[PROGRAMMING NOTE: ONCE GO THROUGH ALL MEASURES MOVE TO FR4]

FR4. Without the PSE Multifamily Retrofit program, how likely would you have been to conduct an energy audit of this property at < ADDRESSx>? Would you have been very likely, somewhat likely, not very likely, or very unlikely?

Very likely	1
Somewhat likely	2
Not very likely	3
Very unlikely	4
[Don't know]	97
[Refused]	98

[IF DI_Meas=0, THEN SKIP TO FR6, ELSE ASK FR5a]

FR5a. Without the energy audit, what would have been the likelihood of installing any of the direct install measures <DI_Measures> that the program contractor installed? Would you have been very likely, somewhat likely, not very likely or very unlikely?

Very likely	1	FR5b
Somewhat likely	2	FR5b
Not very likely	3	FR6 (Measure1)
Very unlikely	4	FR6 (Measure1)
[Don't know]	97	FR6 (Measure1)
[Refused]	98	FR6 (Measure1)

FR5b. Without the energy audit, which of the direct install measures do you think you would have been likely or very likely to install? [READ EACH 1-YES, 2RECORD ALL THAT APPLY]

		Yes	No	Don't know	Refused	
Compact fluorescent light bulbs	1	1	2	97	98	FR6 (Measure 1)
ENERGY STAR LED light bulbs	2	1	2	97	98	FR6 (Measure 1)
ShowerStart showerheads/adaptors	3	1	2	97	98	FR6 (Measure 1)
Water heater pipe wrap	4	1	2	97	98	FR6 (Measure 1)
Advanced power strips	5	1	2	97	98	FR6 (Measure 1)
Faucet aerators	6	1	2	97	98	FR7 for this measure

[PROGRAMMING NOTE: REPEAT FR6 – FR11 FOR EACH REGULAR MEASURE INSTALLED]

FR6. Without the energy audit, what would have been the likelihood of installing <Measure_Group_x_Description>? Would you have been very likely, somewhat likely, not very likely or very unlikely?

Very likely	1	FR7
Somewhat likely	2	FR7
Not very likely	3	FR7
Very unlikely	4	FR7
[I did not install that measure]	5	FR6 (Next measure) or SPILL1a
[Don't know]	97	FR7
[Refused]	98	FR7

FR7. Without the program, what would have been the likelihood of installing <Measure_Group_x_Description>? Would you have been very likely, somewhat likely, not very likely or very unlikely?

Very likely	1	FR8a
Somewhat likely	2	FR8a
Not very likely	3	FR8a
Very unlikely	4	FR6 (Next measure) or SPILL1a
[Don't know]	97	FR8a
[Refused]	98	FR8a

FR8a. Without the rebate from the program, would you have installed <Measure_Group_x_Description> at the same time as you did, earlier, later, or would you not have installed it/them?

At the same time	1	FR9a
Earlier	2	FR9a
Later	3	FR8b
Never	4	FR9a
[Don't know]	97	FR9a
[Refused]	98	FR9a

FR8b. Approximately how many months later would you have installed <Measure_Group_x_Description>? [PROMPT: IF NECESSARY, TRY FRAMING THE TIME AS BEGINNING WITH MORE OR LESS THAN TWO YEARS LATER.]

[RECORD NUMBER OF MONTHS]	1	FR9a
[Don't know]	97	FR9a
[Refused]	98	FR9a

[PROGRAMMER NOTE: The Efficiency (FR9) and Quantity (FR10) Questions are NOT asked about all technologies. This table provides a list of which technologies get which questions]

Measure	FR9 Efficiency	FR10 Quantity
attic insulation	1	0
boilers	1	1
common area lighting	0	1
energy efficient clothes washers	1	1
energy efficient heat pumps	1	1
energy efficient water heaters	1	1
Energy star lighting fixtures		
floor insulation	1	0
high efficiency natural gas fireplaces	1	1
natural gas furnaces	1	1
pool heat pumps	1	1
refrigerator replacements	1	1
thermostatic restrictor showerheads	0	1
windows	1	1

FR9a. I'd like to know about the effect, if any, this program had on the efficiency of your installed <Measure_Group_x_Description> equipment. Without the rebate from the program, would you say the efficiency would have been higher, lower, or, the same or would you **not** have installed any?

Higher	1	FR10a
Lower	2	FR9b
About the same	3	FR10a
Would not have installed any	4	FR10a
[Don't know]	97	FR10a
[Refused]	98	FR10a

1)

FR9b. How much lower would the efficiency have been? Would it have been standard efficiency or according to code, slightly higher than standard efficiency, about midway between standard and the high efficiency that was used, or slightly lower than the high efficiency that was used?

Standard efficiency or according to code	1	FR10a
Slightly higher than standard efficiency	2	FR10a
About midway between standard and the high efficiency that was used	3	FR10a
Slightly lower than the high efficiency that was used	4	FR10a
[Don't know]	97	FR10a
[Refused]	98	FR10a

FR10a. I'd like to know about the effect, if any, this program had on the scale of your installed <Measure_Group_x_Description> projects. Without the rebate from the program, would you have installed more <Measure_Group_x_Description>, fewer, about the same amount, or would you **not** have installed any?

More	1	FR11
Fewer	2	FR10b
About the same amount	3	FR11
Would not have installed any	4	FR11
[Don't know]	97	FR11
[Refused]	98	FR11

FR10b. By approximately what percentage do you think you increased the amount of <Measure_Group_x_Description> due to the program?

[RECORD PERCENTAGE]	1	FR11
[Don't know]	97	FR11
[Refused]	98	FR11

FR11. Without the assistance of the contractor who installed the energy efficiency measures, what would you say would have been the likelihood of installing <Measure_Group_x_Description>? Would you have been very likely, somewhat likely, not very likely or very unlikely?

Very likely	1	FR6 (Next measure) or SPILL1a
Somewhat likely	2	FR6 (Next measure) or SPILL1a

Not very likely	3	FR6 (Next measure) or SPILL1a
Very unlikely	4	FR6 (Next measure) or SPILL1a
NA – I did not use a contractor to install this measure	96	FR6 (Next measure) or SPILL1a
[Don't know]	97	FR6 (Next measure) or SPILL1a
[Refused]	98	FR6 (Next measure) or SPILL1a

[PROGRAMMING NOTE: ONCE LAST MEASURE COMPLETE, GO TO SPILL1a]

Like spillover/future measures

SPILL1a. Since receiving the energy audit from the PSE multifamily retrofit program, have you installed any energy-efficient measures recommended by the audit for which you have not applied for a program rebate?

[Yes]	1	SPILL1b
[No]	2	SPILL2a
[Don't know]	97	SPILL2a
[Refused]	98	SPILL2a

SPILL1b. Which measures have you installed, and how many of them have you installed? [DO NOT READ. SELECT ALL THAT APPLY] [NOTE: INCLUDE 'CUSTOM' MEASURES IN THE OTHER CATEGORY]

EE Measure	Code	EE Measure	Code
[In-unit clothes washer]	1	[Electric to natural gas water heat fuel conversion]	13
[Windows and sliding glass doors]	2	[In-unit furnace]	14
[In-unit water heater]	3	[In-unit fireplace]	15
[In-unit refrigerator]	4	[In-unit boiler]	16
[Refrigerator recycling]	5	[In-unit integrated space and water heating boiler]	17
[Whole house ventilation system]	6	[Other (Specify)]_____	77
[Attic, floor, and wall insulation]	7	[DON'T KNOW]	97
[CFL fixtures]	8	[REFUSED]	98
[LED fixtures]	9		
[Fluorescent fixtures]	10		
[Heat pump water heater]	11		
[Common area lighting]	12		

SPILL2a. Do you plan to install any additional audit recommendations that you have not gotten to yet?

[Yes]	1	SPILL2b
[No]	2	SPILL3a
Installed all audit recommendations	3	SATIS1
[Don't know]	97	SPILL3a
[Refused]	98	SPILL3a

SPILL2b. Which measures do you plan to install, and how many do you plan to install?

EE Measure	Code	EE Measure	Code
[In-unit clothes washer]	1	[Electric to natural gas water heat fuel conversion]	13
[Windows and sliding glass doors]	2	[In-unit furnace]	14
[In-unit water heater]	3	[In-unit fireplace]	15
[In-unit refrigerator]	4	[In-unit boiler]	16
[Refrigerator recycling]	5	[In-unit integrated space and water heating boiler]	17
[Whole house ventilation system]	6	[Other (Specify)]_____	77
[Attic, floor, and wall insulation]	7	[DON'T KNOW]	97
[CFL fixtures]	8	[REFUSED]	98
[LED fixtures]	9		
[Fluorescent fixtures]	10		
[Heat pump water heater]	11		
[Common area lighting]	12		

SPILL3a. Are there any audit recommendations that you do not plan to install?

[Yes]	1	SPILL3b
[No]	2	SPILL4a
[Don't know]	97	SPILL4a
[Refused]	98	SPILL4a

SPILL3b. Which measures do you not plan to install?

EE Measure	Code	EE Measure	Code
[In-unit clothes washer]	1	[Electric to natural gas water heat fuel conversion]	13
[Windows and sliding glass doors]	2	[In-unit furnace]	14
[In-unit water heater]	3	[In-unit fireplace]	15
[In-unit refrigerator]	4	[In-unit boiler]	16
[Refrigerator recycling]	5	[In-unit integrated space and water heating boiler]	17
[Whole house ventilation system]	6	[Other (Specify)]_____	77
[Attic, floor, and wall	7	[DON'T KNOW]	97

insulation]			
[CFL fixtures]	8	[REFUSED]	98
[LED fixtures]	9		
[Fluorescent fixtures]	10		
[Heat pump water heater]	11		
[Common area lighting]	12		

SPILL3c. Why do you have no plans to install these recommended measures? [DO NOT READ. SELECT ALL THAT APPLY]

[Financial limitations]	1	[Fuel prices were low]	10
[Already did all cost-effective energy efficiency improvements]	2	[New to building]	11
[Unaware of/unable to identify measures]	3	[Timing]	12
[Tenants pay their own utility bills]	4	[Technology unavailable]	13
[Lack of maintenance staff to install measures]	5	[Replacing on an as-needed basis]	14
[Lack of time/not a priority]	6	[It was unnecessary]	15
[Question reliability of energy efficient equipment]	7	Anything Else [Other - SPECIFY] _____	77
[Lack of information on energy savings or costs]	8	[Don't know]	97
[Energy savings estimates for equipment are unreliable]	9	[Refused]	98

SPILL4a. Are there any energy efficiency improvements that you implemented that were not recommended or incentivized through the rebate program?

[Yes]	1	SPILL4b
[No]	2	SATIS1
[Don't know]	97	SATIS1
[Refused]	98	SATIS1

SPILL4b. What improvements have you made?

[Record answer] _____ _____	1	[Don't know]	97
		[Refused]	98

Customer satisfaction

Next I have a few questions about how satisfied you were with different aspects of this program.

SATIS1. For each of the following program components, please tell me how satisfied or dissatisfied you were, using a scale from one to five, where one is very dissatisfied and five is very satisfied. [PROGRAMMER NOTE: ROTATE ATTRIBUTES A-G. ANCHOR H, ALWAYS ASKING LAST]

		Very dissatisfied				Very satisfied	Don't know	Refused	Not applicable
a	The energy audit	1	2	3	4	5	97	98	99
b	The direct install measures	1	2	3	4	5	97	98	99
c	The audit report with suggested measures	1	2	3	4	5	97	98	99
d	The rebate application form	1	2	3	4	5	97	98	99
e	The rebate timeliness	1	2	3	4	5	97	98	99
f	The contractor who did the direct install measures on the same day as the audit	1	2	3	4	5	97	98	99
g	The contractor who installed the additional measures after the audit	1	2	3	4	5	97	98	99
h	Your overall experience with the multifamily program	1	2	3	4	5	97	98	99

SATIS2a [Only ask if SATIS1a ≤ 3] Why were you less than satisfied with the energy audit? [DO NOT READ. SELECT ALL THAT APPLY]

[Audit was difficult to schedule]	1	[I didn't get any free equipment]	6
[Auditor showed up late]	2	[Other - SPECIFY] _____	77
[Audit took too long]	3	[No reason]	78
[Auditors were unprofessional/discourteous]	4	[Don't know]	97
[Audit didn't teach me anything new]	5	[Refused]	98

SATIS2b - [Only ask if SATIS1b ≤ 3] Why were you less than satisfied with the direct install measures? [DO NOT READ. SELECT ALL THAT APPLY]

[Didn't get any]	1	[Other - SPECIFY] _____	77
[Didn't save energy with them]	2	[No reason]	78
[They are worse than my old measures]	3	[Don't know]	97
[They broke/burned out/were low quality]	4	[Refused]	98

SATIS2c - [Only ask if SATIS1c ≤ 3] Why were you less than satisfied with the audit report with suggested measures? [DO NOT READ. SELECT ALL THAT APPLY]

[Didn't get any suggestions that I wasn't already aware of]	1	[No reason]	78
[The report didn't have the measures I wanted to do]	2	[Don't know]	97
[Wanted more info about next steps, e.g. finding contractors]	3	[Refused]	98
[Other - SPECIFY] _____	77		

SATIS2d - [Only ask if SATIS1d ≤ 3]. Why were you less than satisfied with the rebate application form? [DO NOT READ. SELECT ALL THAT APPLY]

[Form difficult to obtain]	1	[Other - SPECIFY] _____	77
[Form difficult to submit (not accepted electronically)]	2	[No reason]	78
[Instructions are not clear (needs examples)]	3	[Contractor completed form]	96
[Form required too much information]	4	[Don't know]	97
[Form difficult to complete]	5	[Refused]	98
[Form required too much redundancy]	6		

SATIS2e - [Only ask if SATIS1e ≤ 3]. Why were you less than satisfied with the timeliness of the rebate payment? [DO NOT READ. SELECT ALL THAT APPLY] [IF NECESSARY: PROBE FOR HOW LONG REBATE PAYMENT TOOK]

[Took too long -between 30-60 days]	1	[Had to follow up and request payment]	6
[Took too long - between 61-90 days]	2	[Other - SPECIFY] _____	77
[Took far too long - Over 90 days]	3	[No reason]	78
[Rebate was sent to the wrong address]	4	[Don't know]	97
[Rebate was never received]	5	[Refused]	98

SATIS2f - [Only ask if SATIS1f ≤ 3] Why were you less than satisfied with the contractor who did the direct install measures during the audit? [DO NOT READ. SELECT ALL THAT APPLY]

[Contractor showed up late]	1	[Other - SPECIFY] _____	77
[Contractor broke something]	2	[No reason]	78
[Contractor was unprofessional/discourteous]	3	[Don't know]	97
[Contractor was messy/disruptive]	4	[Refused]	98

SATIS2g - [Only ask if SATIS1g ≤ 3] Why were you less than satisfied with the contractor who installed the additional measures after the audit? [DO NOT READ. SELECT ALL THAT APPLY]

[Contractor showed up late]	1	[Other - SPECIFY] _____	77
[Contractor broke something]	2	[No reason]	78
[Contractor was unprofessional/discourteous]	3	[Don't know]	97
[Contractor was messy/disruptive]	4	[Refused]	98

SATIS2h - [Only ask if SATIS1h ≤ 3] Why were you less than satisfied with the program overall? [DO NOT READ. SELECT ALL THAT APPLY]

[Not pleased with performance of the equipment]	1	[Other - SPECIFY] _____	77
[Not pleased with energy savings]	2	[No reason]	78
[Not pleased with the contractor]	3	[Don't know]	97
[Aesthetics-- system does not look good etc.]	4	[Refused]	98

SATIS3. What, if anything, does the program do well?

[Record answer] _____ _____ _____ _____	1	[Nothing done well]	2
		[Don't know]	97
		[Refused]	98

SATIS4. What suggestions, if any, do you have for improving the program?

[Record answer] _____ _____ _____ _____	1	[No suggestions]	2
		[Don't know]	97
		[Refused]	98

Firmographics [skip to end if DM6=5]

Finally, I'd like to ask some questions about your company's structure and the characteristics of <ADDRESS LIST> that we've been discussing. This information won't be shared to any third parties and is only used in the aggregate level to characterize the results.

FIRM1a. Where is your company headquartered?

[RECORD RESPONSE]	1
[DON'T KNOW]	97
[REFUSED]	98

FIRM2. Does your company own or rent the properties that you manage?

Own	1
Rent	2
[Both own and rent]	3
[Other – Specify _____]	77
[DON'T KNOW]	97
[REFUSED]	98

FIRM3. How many properties does your company own or manage?

[Record Number]	1
[DON'T KNOW]	97
[REFUSED]	98

[PROGRAMMER NOTE: LOOP THROUGH FIRM4-FIRM9 FOR EACH ADDRESS]

FIRM4. Is the property at <ADDRESSx> an apartment building, a condominium, or something else?

Apartment building	1
Condominium	2
Other (Specify_____)	77
[DON'T KNOW]	97
[REFUSED]	98

FIRM5. When was this property built? [IF DOESN'T KNOW EXACT YEAR, PROMPT FOR ONE OF THE PRE-CODED OPTIONS]

[Record Year Built]	1
Before 1940	2
1940 to 1949	3
1950 to 1959	4
1960 to 1969	5
1970 to 1979	6
1980 to 1989	7
1990 to 1999	8
2000 to 2009	9
2010 to present	10
[DON'T KNOW]	97
[REFUSED]	98

FIRM6. How many tenant units are there in this facility at <ADDRESSx>?

[Record Number]	1
[DON'T KNOW]	97
[REFUSED]	98

FIRM7. When thinking about the income levels of the tenants at this property, which of the following characterizes the property best: mostly low income; mostly middle income; mostly upper income; somewhat diverse, with low and middle income tenants; somewhat diverse with middle and upper income tenants; or very diverse with low, middle, and upper income tenants?

Mostly low income	1
Mostly middle income	2
Mostly high income	3
Somewhat diverse, with low and middle income tenants	4
Somewhat diverse with middle and upper income tenants	5
Very diverse with low, middle, and upper income tenants	6
[DON'T KNOW]	97
[REFUSED]	98

FIRM8. Does this property have a centralized heating system or individual units?

Centralized	1
Individual	2
[DON'T KNOW]	97
[REFUSED]	98

FIRM9. Does this property have a centralized cooling system or individual units?

Centralized	1
Individual	2
No cooling system	3
[DON'T KNOW]	97
[REFUSED]	98

END
That concludes our survey. We appreciate your participation in Puget Sound Energy's Multifamily Retrofit Program, as well as your input for this survey. Thank you for your time.

APPENDIX C. SURVEY TOPICS WHERE FULL AND STALLED PARTICIPANTS AGREED

There were also some survey topics where there were no statistically-significant differences between full participants and stalled participants. Such findings can be useful in helping to determine which barriers to full program participation may be less important. The following are some of these survey topics:

- Finding the right decision-maker: One of the PSE program actors we interviewed mentioned that difficulties in reaching the right decision-maker for a multifamily property can be a significant barrier to program recruitment. In our surveys of full participants and stalled participants we asked the respondents to identify their job titles. There were no statistically-significant differences between the full participants and the stalled participants in terms of the frequency with which they identified any particular job title. Since the full participants had a very similar mix of job titles as the stalled participants, this suggests that the more complete participation of the full participants was not because the program reached better decision-makers (or if they had, the better decision-makers were not identified in the program tracking database).

- The split incentive barrier: Theory suggests that when tenants pay their own utility bills, there is a greater chance of split incentive barriers because landlords have no incentives to purchase energy-efficient equipment. When we asked both full participants and stalled participants whether tenants pay for their own utility bills, the percentage of tenants who pay their own bills was not different to a statistically-significant degree between the two groups. This suggests that the split incentive barrier was not an explanatory factor as to why stalled participants did not progress further in the program

- Recalling the audit: The survey asked the two participant groups whether they recalled receiving an energy audit. One might expect a higher percentage of stalled participants to not remember if they got an audit since they received services several years ago, while full participants received services in 2014. Yet the two groups had similar levels of recall for receiving an audit, with less than half recalling the audit. The stalled participants had a higher percentage of those who said they did not know if they got an audit, but it was not significantly higher. This lower level of audit recall by both stalled and full participants indicates a potential lack of awareness about the audit that occurs during this program. Other reasons could be that the person answering the survey was not the person onsite with the auditor and was not aware of exactly what happened during the visits. In either case, it does not seem that the audit itself made a significant impact on the decision to participate in the program.

- Program satisfaction: When we compared average satisfaction ratings between full participants and stalled participants, the full participants were more satisfied than the stalled participants for only one of the six program activities. At first glance, this suggests that lack of satisfaction was not a significant reason why the stalled participants did not move further along in the program. Yet it is important to note that satisfaction with the overall program was the one satisfaction category where the full participants had a higher average satisfaction rating (to a statistically-significant degree) than stalled participants. In addition, as discussed below, the average satisfaction rating metric, which removes the "don't know" and "not applicable" responses," probably does bias the satisfaction ratings somewhat since some of the lack of recall may be due to negative program outcomes (e.g., a program energy audit that was not very memorable)..

APPENDIX D. STALLED PARTICIPANT SURVEY RESULTS

Firmographics

When we asked the stalled participants for their job title, as seen in Figure 18, the most common response was a property/residence manager (41%). Another 49% of respondents reported they were a manager of some kind (e.g. general manager). Six percent of respondents identified themselves as being the property owner. The large majority (89%) of respondents reported that they worked onsite at the property in discussion. Seven percent said they worked in the corporate office and 4% in a home office.

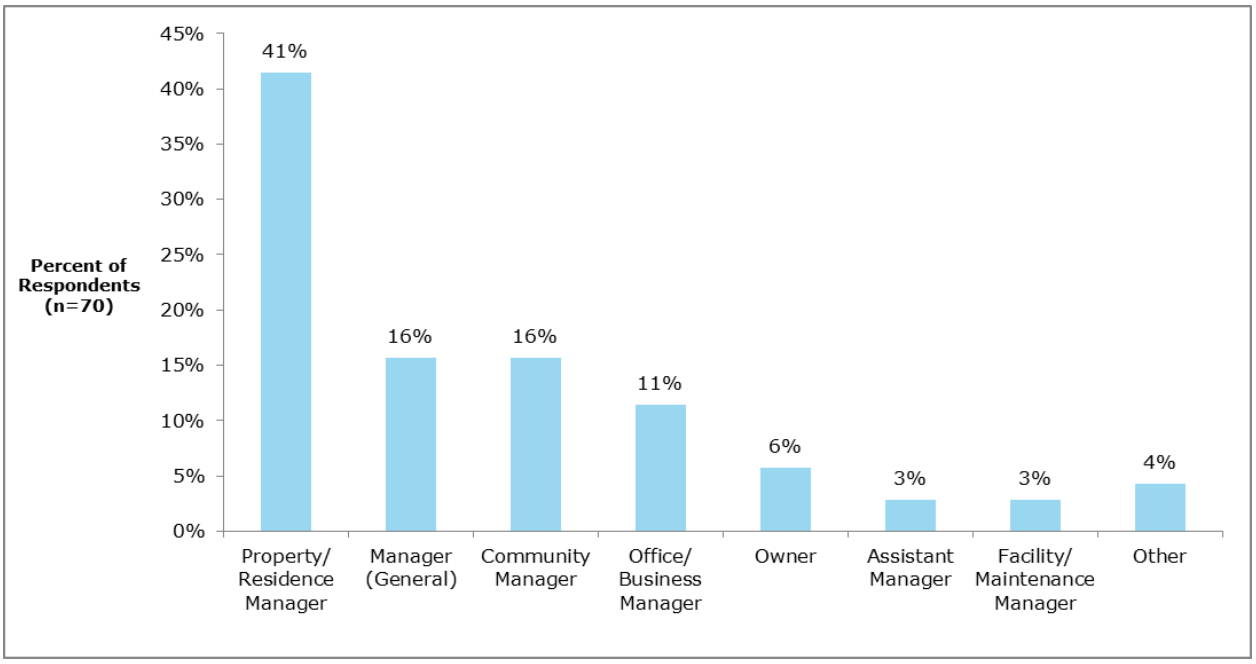

Figure 18: Respondent job title

The large majority (77%) of respondents reported that they own or manage the properties. There were some statistically-significant differences in the survey response frequencies of various subgroups.[21] Those with 25 or fewer properties were more likely to say that they owned their properties than that they rented or managed them. The majority (61%) of the property management companies or owners reported being based in Washington, compared with 26% saying they were outside of Washington. Thirteen percent of respondents refused to answer. Representatives of older properties (46 years and up) were more likely to report they were based in Washington than representatives of younger properties (Figure 19).

[21] We define statistically significant as a percentage that falls within the 90% confidence using an unpooled z-test.

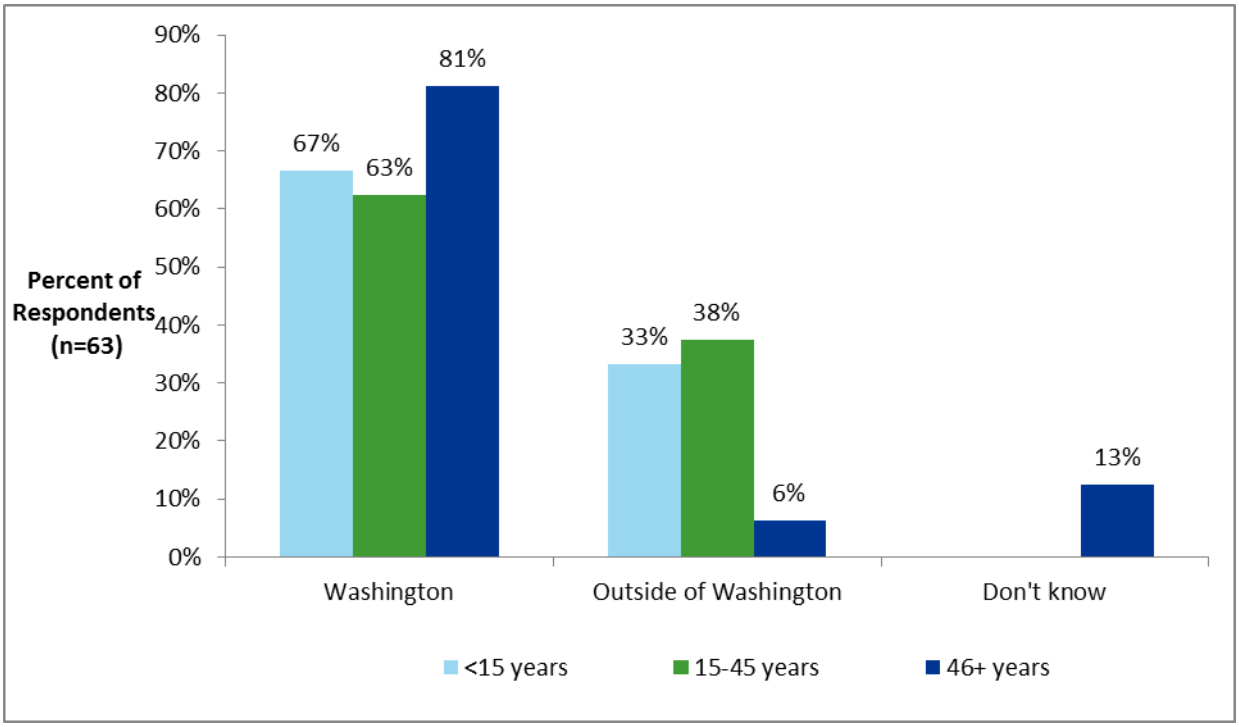

Figure 19: Location of property management company[22]

Eighty-three percent of the respondents said their property was an apartment building (versus a condominium or something else). The reported construction dates of the properties ranged from as early as pre-1940 to the present, with the average year being 1978 and the median being 1985.

There was a general trend for representatives of newer properties to report having more units, and to be part of larger management companies than those representing older properties. This is in line with PSE staff reports of a boom in the construction of larger style apartment and condo buildings in recent years. The number of properties they reported managing ranged from one to 500 with a mean of 49 and a median of 20. Figure 20 shows that properties built in the last 15 years were on average much larger than those built earlier.

The number of reported tenant units per property ranged from 5 to 696, with an average of 104 and a median of 69. Managers of newer multifamily properties tended to report having a higher number of units per property. The figure shows that respondents with properties in both the under 15 and 15 to 45 years old age categories reported having over 120 units per property, on average. In contrast, respondents with properties in the 46 and older building age category reported having an average of just 45 units per property.

[22] Properties less than 46 years old were statistically significantly more likely to be managed by companies located outside of Washington State than properties 46 years or older.

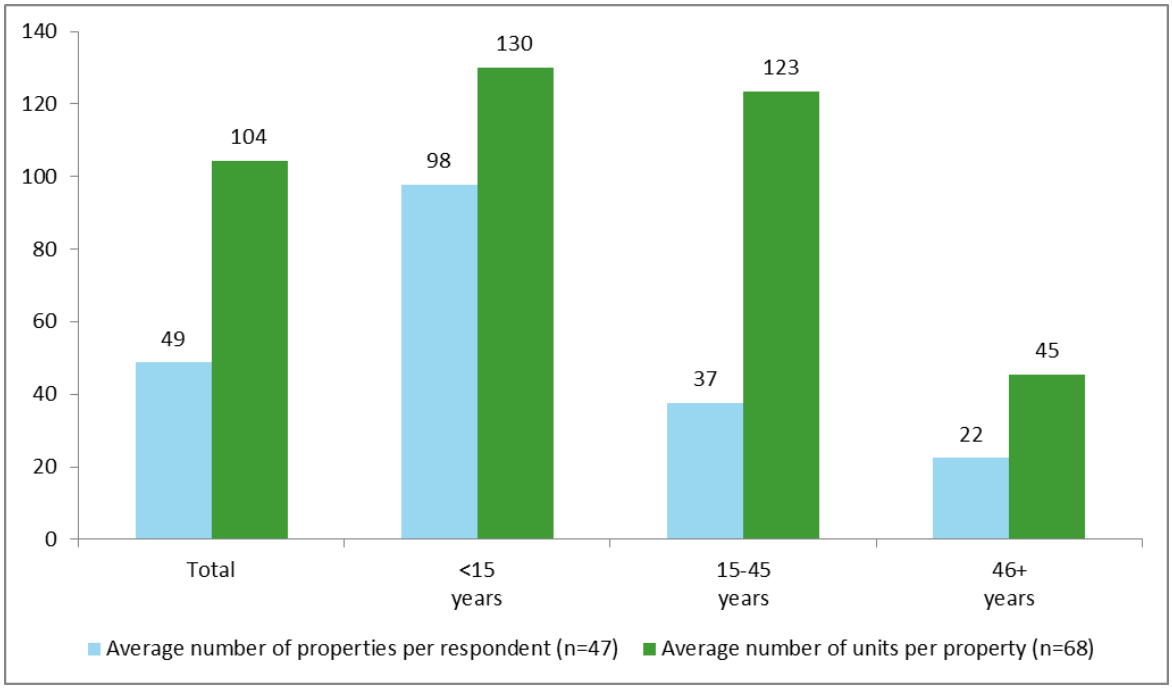

Figure 20: Average number of properties per owner and average number of units per property by age of property

We asked the stalled participants to generalize about the income of their tenants. Managers representing one-quarter of the properties reported their tenants as being mostly middle income, while managers representing 51% of properties said that their tenants had more varied levels of income (Figure 21). Nine percent of the properties were reported as being mostly low-income properties. The managers of these low-income properties expressed higher levels of overall satisfaction with the program than managers of other properties. In other evaluations we have conducted of low-income program participants, we often see higher levels of participant satisfaction than we see with non-low-income program participants. We normally attribute this higher satisfaction to receiving more free measures in the low-income programs relative to the non-low-income programs.

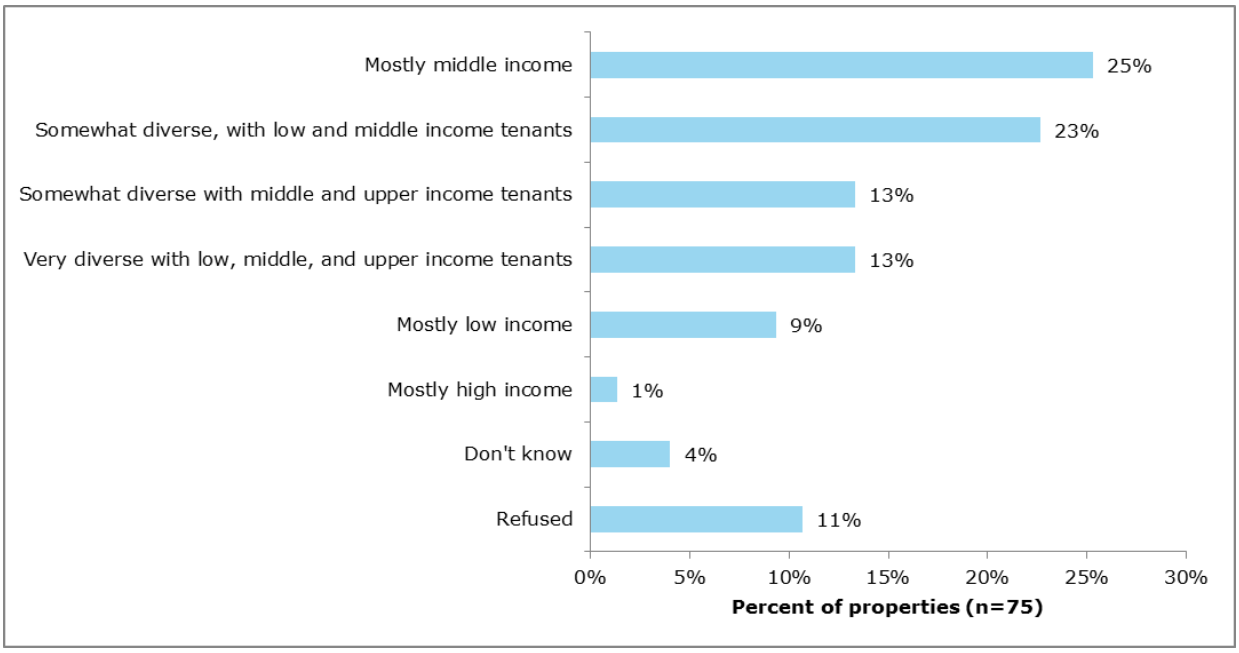

Figure 21: Income characterization of stalled participant properties

We asked the stalled participants whether their tenants paid their own utility bills. As shown in Figure 22, managers representing the majority (59%) of the properties said that their tenants pay their own bills. Managers representing 91% of properties said that their properties were individually metered for electricity and those representing 59% of the properties which had gas service (69% of all properties reported having no gas service) said that their properties were individually metered for natural gas. The managers also reported that 83% of the properties had individual heating systems and 84% of properties with cooling systems had individual cooling systems. Fifty-two percent of the properties were reported to have no cooling system at all, and 22% reported they did not know if they had a cooling system.

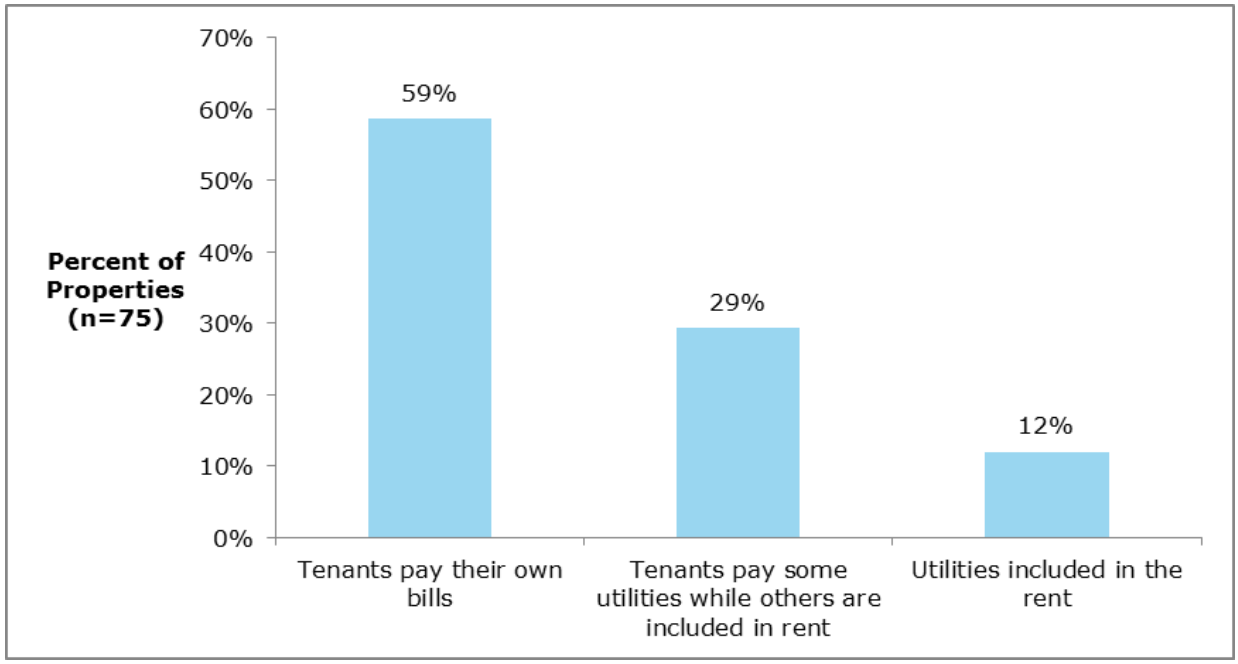

Figure 22: Tenant responsibility for paying utilities

Decision-making process

Before discussing the Multifamily Retrofit Program in particular, the survey asked the stalled participants a series of questions related to their general decision-making process when considering improvements to their properties. We asked them whether they could make decisions on energy efficient equipment on their own, or if there were others involved in the decision.

During our contractor interviews, one contractor identified not being able to meet with the main decision maker as a barrier to program participation. The survey of the stalled participants found that making decisions on energy efficient improvements generally involves multiple decision makers. Over three quarters (76%) of respondents reported that others are involved when they make decisions on improvements to the property. Similarly, 74% reported that they needed additional authorization over a certain dollar limit. Of those who needed additional authorization, the mean dollar amount they had authorization up to was $1,046 and the median was $500. This indicates that while the respondents were people involved in the program, they did not have sole authority on deciding what equipment to install and how much of it to install. The authority generally rested with the owner (33%) or the regional manager (29%), as Figure 23 shows.

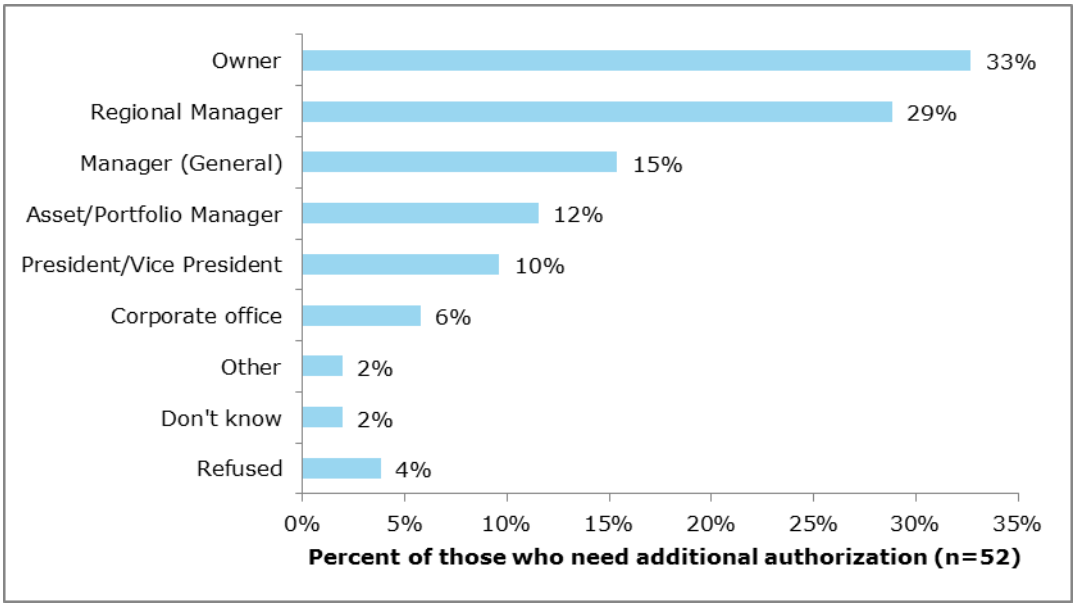

Figure 23: Who has authority to authorize purchases

The survey also asked the stalled participants how they generally made decisions on upgrading energy-using equipment and what factors they considered. Respondents reported online research (31% of respondents) as the most common source of information to help make a decision on upgrading energy-using equipment Other frequently-cited sources of information include vendors (20%) and a colleague or friend (16%). Figure 24 shows the full range of responses. About a quarter (23%) said they did not know which sources they used. Respondents could select more than one option.

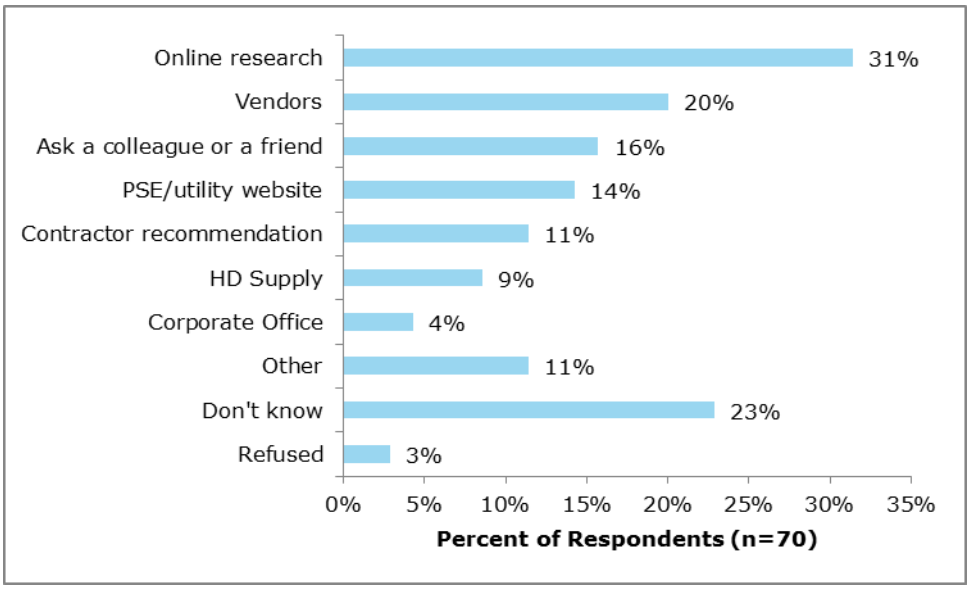

Figure 24: Information sources used to help decision-making process

When asked what the most common factors the property considered when upgrading or replacing energy-using equipment, 60% of respondents reported the cost/price of the equipment. Other top responses were energy savings/energy efficiency (27%) and cost savings over time/future cost savings (21%). Figure 25 shows all of the responses. Responses from program actor interviews back up this information, as several program actors mentioned some of the biggest barriers were lack of capital and energy efficiency as a lower priority. While energy efficiency/energy savings came up as the second most reported option, it was far below the importance of considering cost.

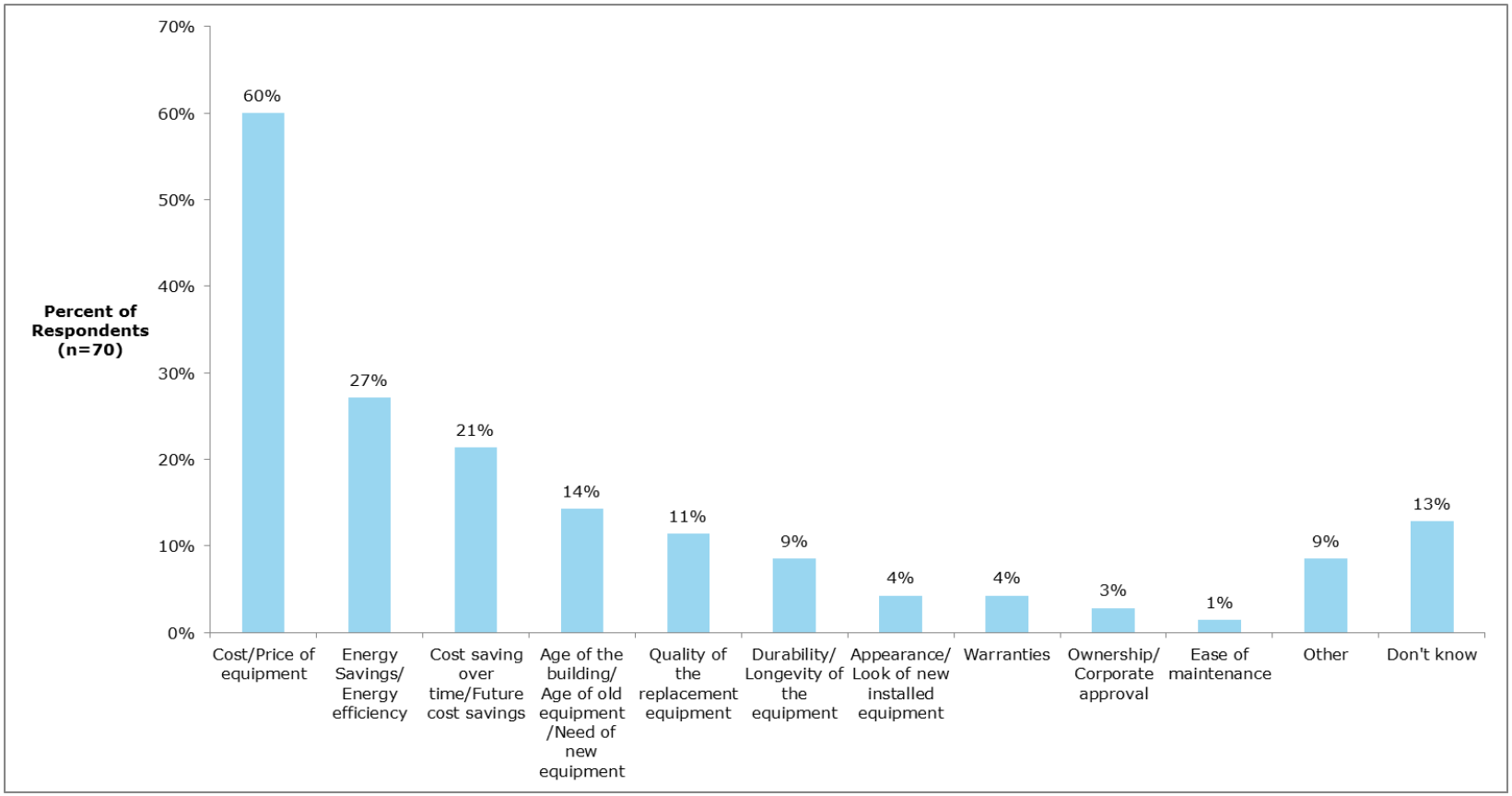

Figure 25: Factors considered when upgrading or replacing energy-using equipment

Note: The total will add to more than 100% as respondents could give multiple responses to this question.

We asked the stalled participants how important energy efficiency was when thinking of upgrading or replacing energy-using equipment. We asked them to use a five-point rating scale in which five indicated "very important" and one indicated "very unimportant." About three-quarters (76%) of respondents reported that the energy efficiency of the equipment was important (a 4 or 5 rating) (Figure 26). The mean score was 4.19. In addition, 87% of the respondents said they considered non-energy benefits, such as reduced maintenance costs, when making equipment replacement decisions. The fact that a large majority of the stalled participants thought that energy efficiency was important indicates that their reasons for not completing their program participation were, for the most part, not due to attitude barriers.

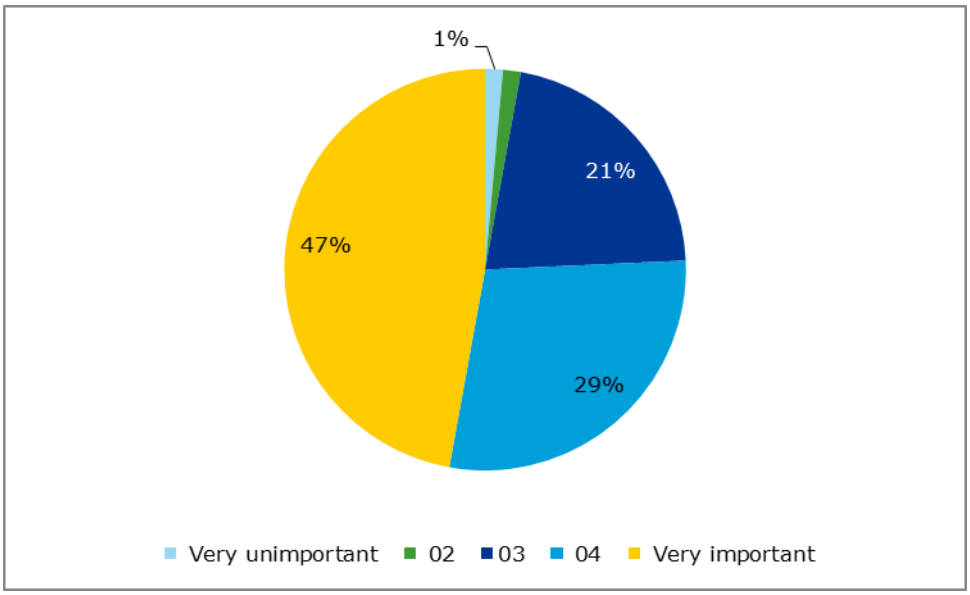

Figure 26: Importance of energy efficiency of the equipment when considering an upgrade or replacement (n=70)

Figure 27 shows the responses respondents gave when we asked them to explain their importance ratings for energy efficiency when making equipment replacement decisions. "The Energy Efficiency Important" group includes those who gave a 4 or 5 importance ratings and the "Energy Efficiency Not Important" group includes those who gave 1, 2, or 3 importance ratings.

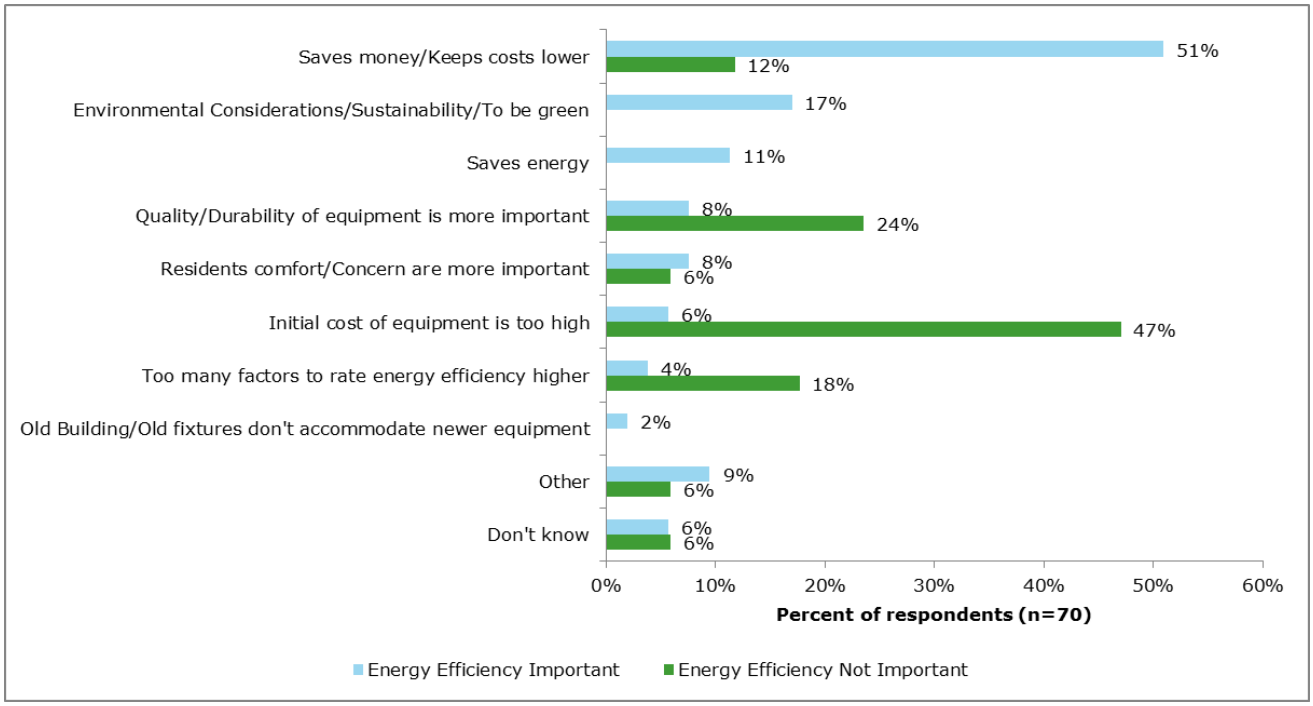

Figure 27: Reasons why energy efficiency is important or not
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

The chart shows that there were some big differences between these two groups in their explanations for these importance ratings. Those who thought energy efficiency was important were more likely to cite saving money/keeping costs lower (51%) versus those who thought it was not important (12%). Seventeen percent of those who thought it was important cited environmental considerations, compared with zero percent of those who thought it was not important. Conversely, those who thought it was not important said it was due to the initial cost of equipment being too high (47%). Only six percent of those who thought energy efficiency was important gave that as a reason.

These findings confirm the conventional wisdom that valuing energy efficiency is correlated with the desire to save money and protect the environment. They also suggest that the higher first cost of equipment is a significant barrier to many stalled participants.

Over half (60%) of the respondents indicated their decision making process for tenant areas and common areas was the same (Figure 28). This was somewhat surprising considering that the split-incentive barrier (tenants paying their own utility bills but landlords making most decisions about the purchase of energy-using equipment) is usually considered to be a major barrier in the multifamily sector. Yet we have found similar findings in our evaluations of multifamily programs in California. In the California studies we found

that a majority of the multifamily property managers supported energy-efficient improvements in the tenant units, even though the tenants paid their own utility bills, because many realized that if the tenants were paying less in utility costs, they would have more money available to pay their rents. Similarly one of the respondents to the PSE stalled participant survey said that their company was doing more in the tenant areas because the residents lived on fixed incomes.

Thirteen percent of the respondents to the PSE stalled participant survey did say their decision-making process was different for common areas vs. tenant units. Their explanations for these differences included common areas being larger spaces that use more energy and other reasons which appear in the chart below. Those respondents whom we classified in the "other" category said that their decision-making process differed depending on what size project budget was approved or what the tenants allow them to do.

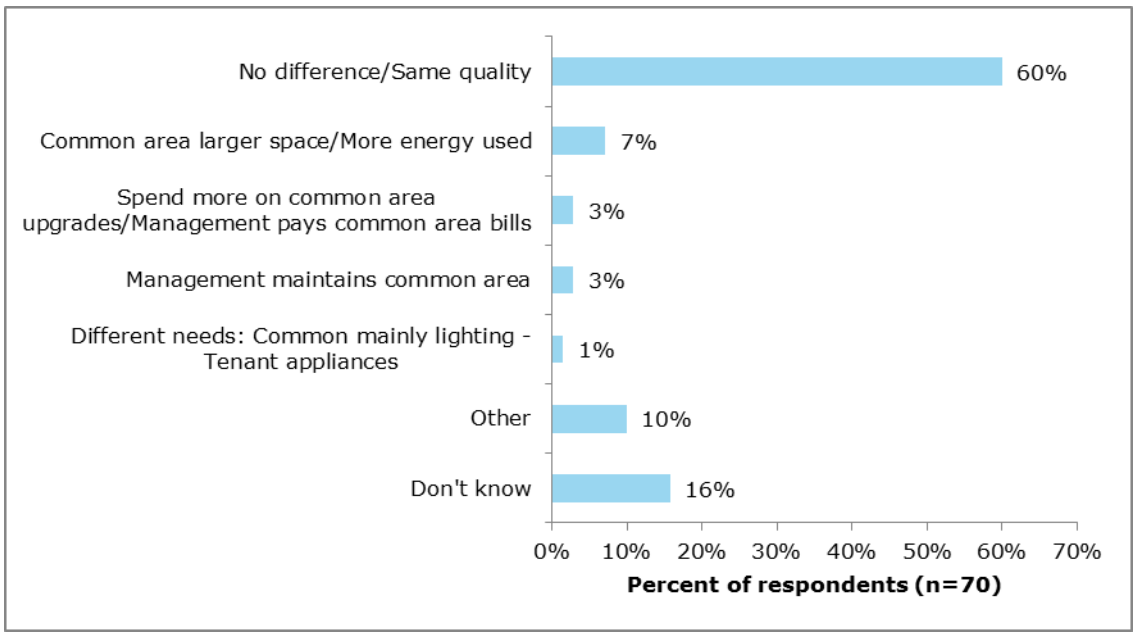

Figure 28: Difference between deciding on upgrades in tenant areas vs. common areas
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

We asked the stalled participants whether there were any particular contractors who they use more frequently for equipment maintenance, upgrades, or replacement. Over a third (36%) of the respondents said they did have a contractor they used more frequently. It was more common for those who managed more than 25 properties to report having a specific contractor they used frequently (55%) than those with fewer than 25 properties (22%). Those who said they used specific contractors most frequently mentioned HD Supply (48% of those using specific contractors more frequently). When we asked the respondents what services they used these specific contractors for, they most frequently reported using them to get appliances (44%) and maintenance supplies (40%). Figure 29 shows all the responses.

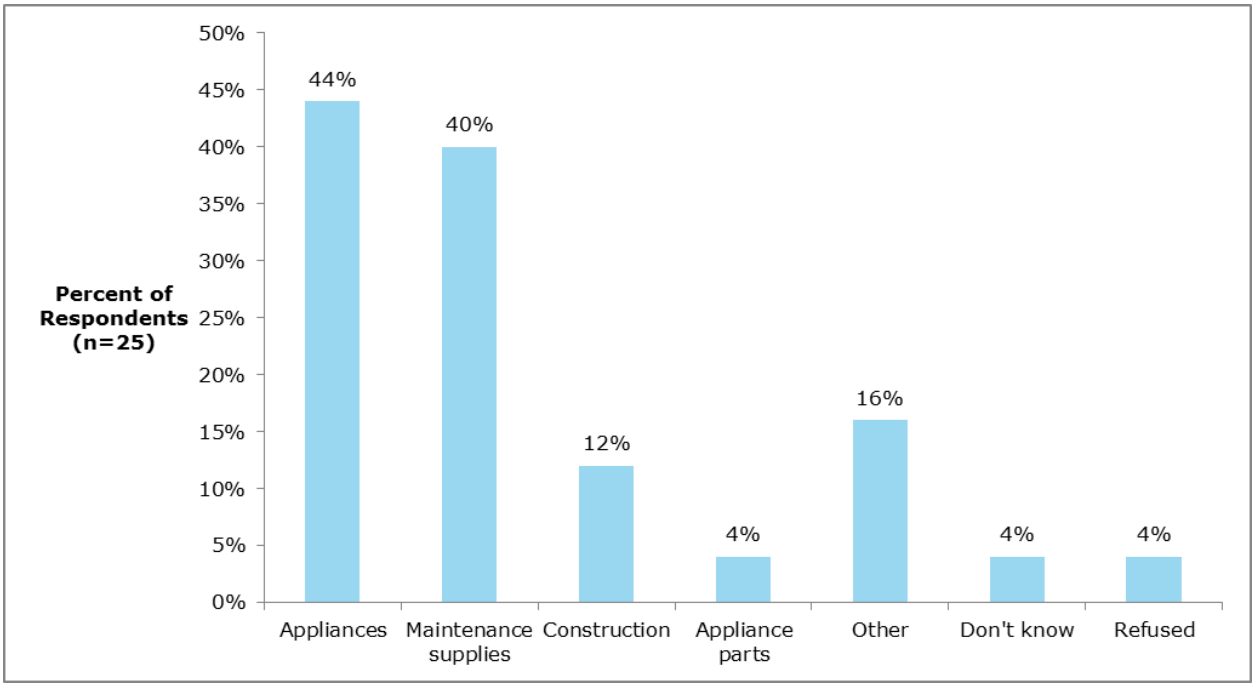

Figure 29: Services that contractors who are frequently used provide
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

Program awareness and program services

We asked the stalled participants about their awareness of the PSE multifamily retrofit program services. Figure 30 shows their responses. One-third of respondents said they did not recall participating in PSE's multifamily retrofit program. They said this even though at the beginning of the survey they had said that they were familiar with their organization's participating in a PSE program for increasing energy efficiency in multifamily buildings between 2010 and 2013. This indicates there could be a lack of awareness of the PSE program name. Those who indicated lower levels of satisfaction with the program were much more likely to say they were not familiar with the program (37%) than those who were satisfied (9%).

There were also high levels of uncertainty among the stalled participants as to which program services they had received. [23] Part of this uncertainty is likely due to the length of time between the receipt of the

[23] All 70 participants received a question related to whether they remembered participating in the program. Initially, those who did not remember skipped to the next section of the survey. However, the high number of respondents who said they did not know prompted us to change the

services and the fielding of the survey, which occurred two to five years after. Only 43% recalled receiving an energy audit, but 73% recalled receiving directly installed energy efficiency measures. Those who recalled the PSE multifamily retrofit program were more likely to have remembered receiving DI measures (91%) versus those who did not recall (60%).

About a quarter (24%) of the stalled participants recalled receiving suggestions for energy efficiency improvements and 29% recalled receiving rebates or incentives for energy efficiency improvements. In theory, none of the stalled participants should have received rebates, but it is possible a few of the stalled participants either eventually became full participants and were not accurately tracked, participated in another PSE program, or there may have been some respondent confusion. Seventeen percent of the respondents recalled receiving assistance in finding contractors to install energy-efficient measures. Those who recalled the PSE multifamily program also had higher recall of receiving different aspects of the program.

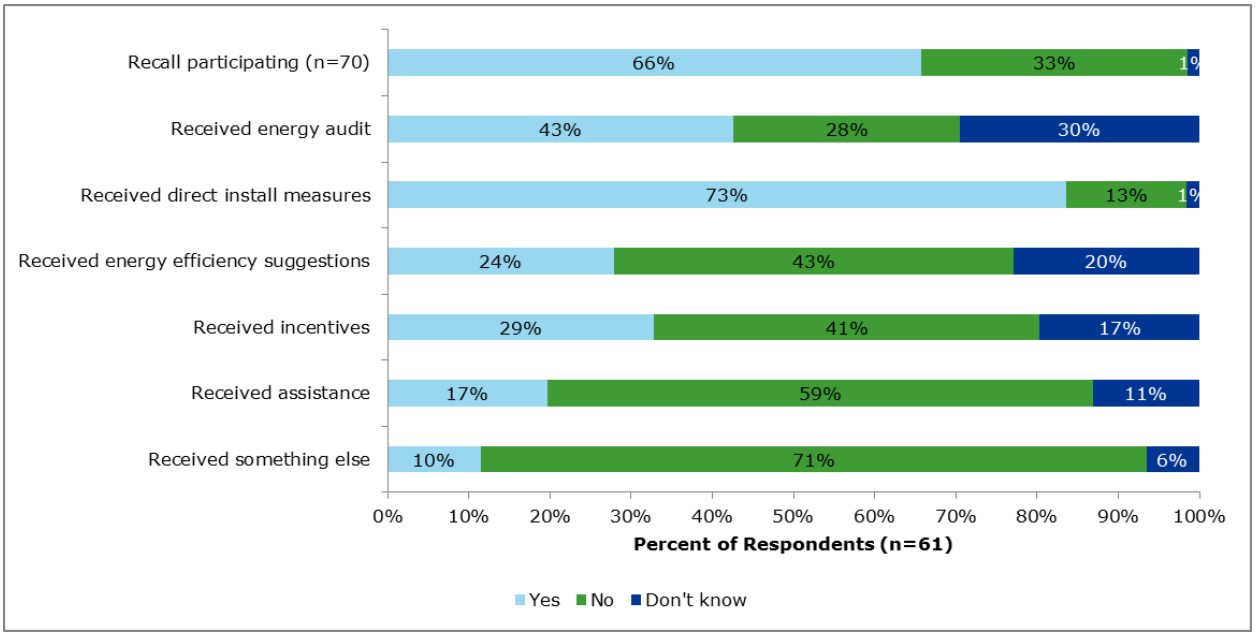

Figure 30: Stalled participant recall on services received as part of program[24]

Nearly a third (30%) of the stalled participants recalled energy efficiency improvements recommended by the audit (Figure 31). We asked these 18 respondents additional questions about these recommendations and their actions. Sixty-one percent of these respondents (18% of the total respondent group) said they did implement some of the recommended improvements. Some of the energy-efficient improvements the respondents mentioned included CFL fixtures, LED fixtures, in-unit refrigerators, in-unit clothes washers, windows and sliding glass doors, and in-unit water heaters. No one reported receiving a rebate for these

skip logic to ask this question for all respondents. Due to skip logic change occurring after the first day of interviewing, only 61 of the 70 respondents received the questions related to the services received.

[24] All 70 participants received a question related to whether they remembered participating in the program. Initially, those who did not remember skipped to the next section of the survey. However, the high number of respondents who said they did not know prompted us to change the skip logic to ask this question for all respondents. Due to skip logic change occurring after the first day of interviewing, only 61 of the 70 respondents received the questions related to the services received.

measures. When we asked them why they did not seek a rebate from PSE, their responses included not knowing about the rebates, believing they were ineligible for them, and not knowing why they did not apply.

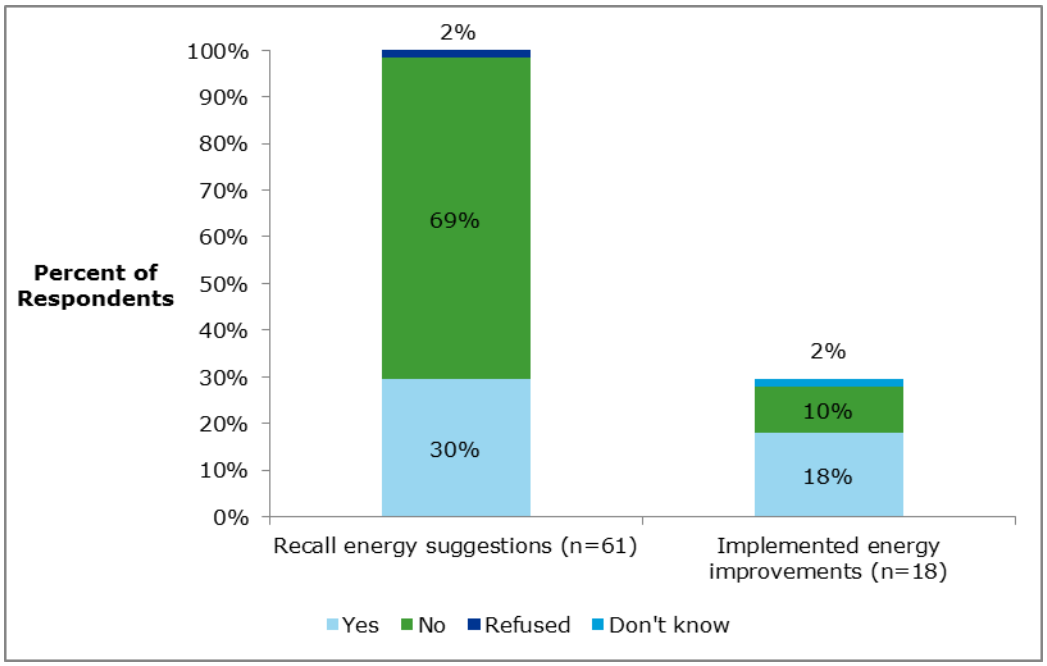

Figure 31: Percent of respondents who recalled energy suggestions and who implemented energy efficiency improvements

Of the 33% of stalled participants who said that they did not install the recommended measures, some of the reasons they gave included thinking it was unnecessary to do so, believing it was not cost-effective, being unable to identify the measures, believing the energy savings estimates were unreliable, or reporting it was not good timing. Only four respondents (22% of those who said they did not install the recommended measures) said they planned to install audit recommendations but had not gotten to yet. These respondents planned to install windows and sliding glass doors (2 respondents), LED fixtures (2), and insulation (1). Only one respondent said there was a measure they do not plan to install. It was LED fixtures, which the respondent said would have increased costs for the tenants, likely due to the higher cost of replacement bulbs.

We asked the stalled participants how important a factor it was that tenants pay for their own utility bills as a reason why they did not make some energy efficient improvements. About a quarter (27%) of them said it was very important. The mean rating on the 1 (very unimportant) to 5 (very important) scale was 3.67.

There was a statistically significant difference between the average importance ratings from those stalled participants who had properties with low-income housing (2.00) and the average importance rating from those with no low-income housing (4.50). This could indicate higher levels of tenant assistance in buildings that have low-income housing where tenants might be less able to afford upgrades on their own. Additionally, the U.S. Department of Housing and Urban Development (HUD) has a program that provides housing assistance to private building owners that own public housing. This program can inadvertently disincentivize energy efficiency because if property managers incorporate energy efficiency, HUD will reduce

their housing assistance payments. When the tenants pay their own bills, however, this disincentive goes away for the property manager.

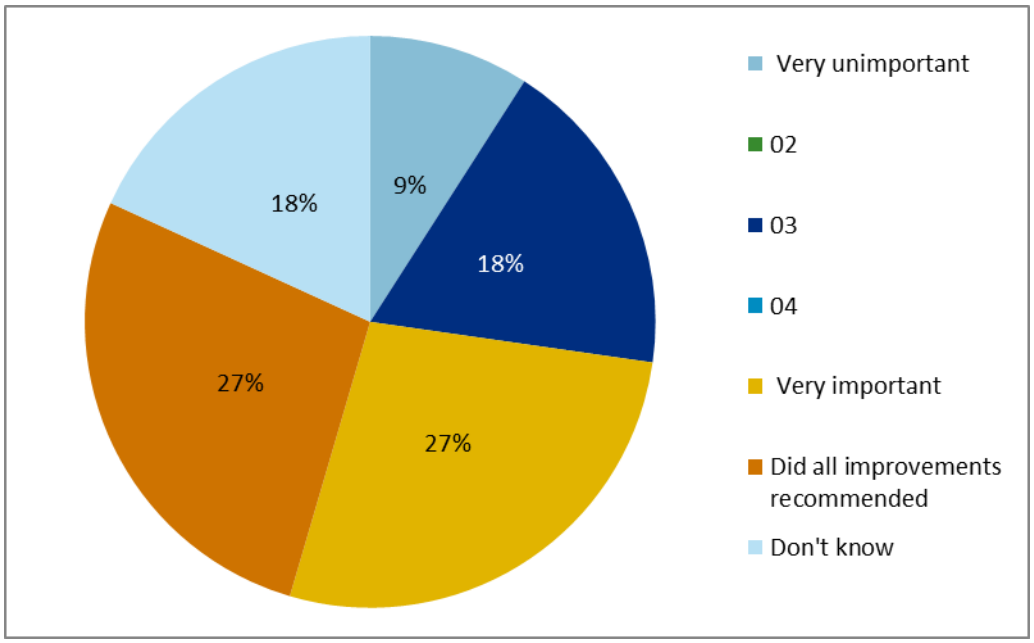

Figure 32: Importance of tenants paying their own utility bills as a reason why stalled participants who recalled audit recommendations did not make any energy efficient improvements (n=11)

Twenty-two percent of those stalled participants who recalled audit recommendations said additional information could have helped them implement some measures. The helpful information they mentioned included having someone come to give a bid for the work, getting back in touch with the implementers, a more detailed breakdown of what is available and the type of resources available to get it, and to receive more information on the measures.

Thirty-three percent of those who recalled the audit recommendations said they would need financial support to implement the recommended measures. As shown in Figure 33, managers of newer buildings were more likely to say they needed financial support compared with managers of older buildings. When asked what type of financial support would help, all six respondents mentioned either a reduced rate on the product or a rebate. They also all preferred incentives and rebates over low-interest loans. These differences in the responses of managers depending on the age of the properties they managed could have to do with the age of equipment in the properties. A newer building would need more of an incentive to upgrade equipment that is still functioning, but isn't the most efficient. An older property would be more likely to have aging equipment with higher maintenance costs.

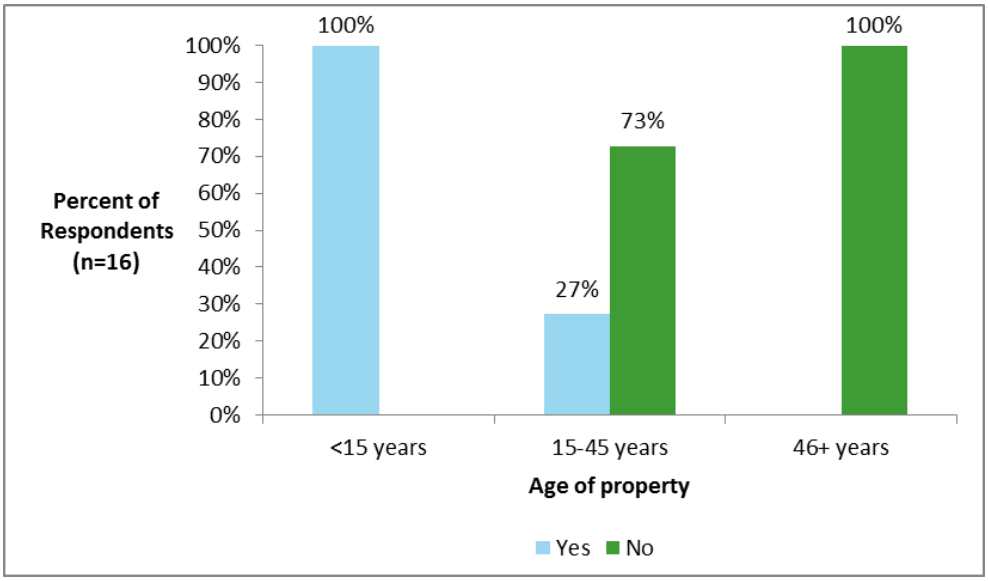

Figure 33: Whether respondent who recalled the audit recommendations would need financial support to implement recommended measures

Over one-third of those who recalled audit recommendations said they were not the decision-maker for whether the organization would consider loans. Of the 11 that gave a response, 64% (7 respondents) were not interested (a 1 or 2 on the scale), 27% were interested (4 or 5) and 1 person (9%) was neutral (3). Those interested thought it could be useful to receive help to pay for the improvements. Those not interested said one is still spending money with a loan and another said they would prefer an incentive. There were two that said they had nothing additional to install and therefore a loan would not increase their odds of installing something. Another respondent said it was more due to being reluctant to inconvenience their tenants rather than it being a financial barrier. We also heard this idea of not wanting to interrupt tenants' routines during the contractor interviews.

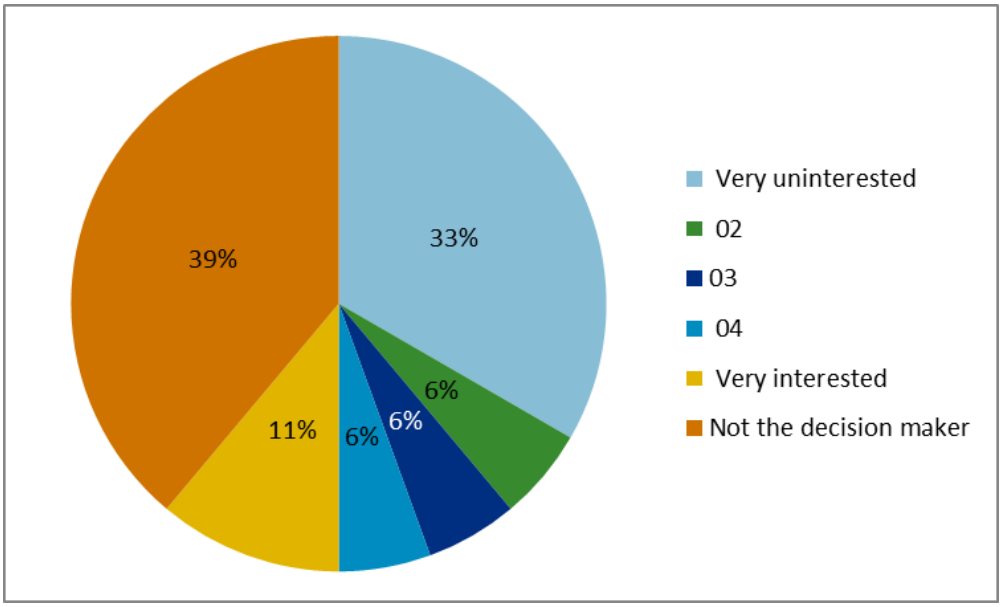

Figure 34: Respondents who recalled the audit recommendations interest in a low-interest loan offered by PSE (n=18)

We asked the eleven respondents who recalled audit recommendations and gave their opinion on the loan program if they installed anything not recommended by the program. One of these respondents reported installing efficient LED lighting that was not recommended by the program. They said that they did not apply for a PSE rebate because they looked online for one, but did not see one available. Of the 42 respondents who did not recall any audit recommendations, six said that they installed energy efficiency measures recently. They reported installing efficient boilers, hot water tanks, outdoor LED lights, and solar panels. All six of these respondents rated energy efficiency as being an important factor in decision-making. Those who said energy efficiency was not important did not report installing any energy efficiency measures. Those with newer properties were less likely to say they had installed energy efficient measures. This could be because these newer properties were built to a higher energy code, so there was less for them to do. As noted previously, the managers of newer properties were also more likely to say that they need financial support to implement energy-efficient improvements. Two of the six respondents reported that they did end up receiving a rebate from the measures they installed. Of the other three, one did not know they could get a rebate for that measure, one had not applied for the rebate yet, and the third had talked with their account representative, but the account representative never filled out the paperwork for them.

Program satisfaction

The survey asked stalled participants about their satisfaction with various aspects of the program related to the energy audit and direct install. We asked respondents to rate each aspect on a scale from 1 to 5, where 1 was very unsatisfied and 5 was very satisfied. Figure 35 shows the mean level of satisfaction for those who gave a numeric response (other accepted responses were "don't know", "refuse to answer", and "not applicable"). A large percentage of respondents responded "don't know" or "not applicable" to many of the satisfaction questions. This could be due to the low levels of awareness or recall about the program discussed earlier in this report. During program actor interviews, several program actors claimed that lack of awareness or knowledge about the program was a barrier to greater participation.

Those stalled participants who were willing to give satisfaction ratings were generally satisfied (all the aspects were rated above a four) with the various aspects of the program (Figure 35). However, the overall experience with the multifamily program was the second lowest satisfaction, with a mean score of 4.30. Of those who reported being less than satisfied with the program overall, over half were not pleased with the performance of the equipment they received. We have found this same correlation between dissatisfaction with the equipment and dissatisfaction with the program as a whole in other multifamily programs of not getting any recommendations for energy-efficient improvements. Even when asked their overall experience with the multifamily program, 17% of the respondents gave a "not applicable" response, which could indicate that they were not involved in enough of the program aspects to give an opinion.

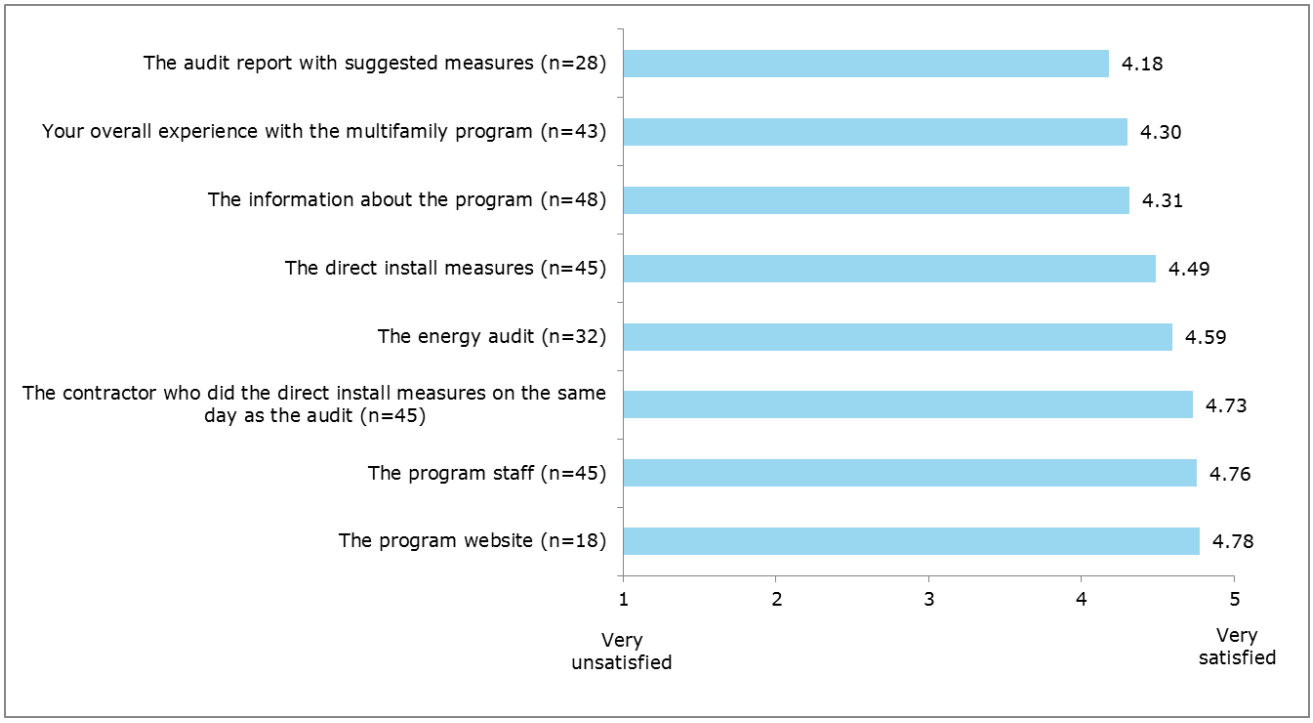

Figure 35: Mean satisfaction with program aspects

The highest level of satisfaction among the stalled participants was with the program website, with a mean score of 4.78. However, 59% of respondents reported they had not been to the website ("not applicable"),

and 16% said they did not know how satisfied they were. Only one respondent was less than satisfied with the website and reported he/she thought the website was average.

When asked about their satisfaction with the information about the program, 68% of the stalled participants provided a satisfaction rating. The average rating was 4.31. Those who reported being less than satisfied with the information said they did receive enough or any information or they did not understand the information they received. In general, those stalled participants who thought energy efficiency was an important thing to consider in upgrades were happier with the information about the program (4.49 vs 3.85). Twenty-two percent of respondents to the question about satisfaction with the program information gave a "not applicable" or "don't know" response. Those who recalled the program reported higher levels of satisfaction with the information about the program and were less likely to say "don't know" or "not applicable". This suggests that some stalled participants did not receive adequate information about the program during their initial visits or that the program information was not sufficiently memorable.

Over half the stalled participants indicated that the energy audit was "not applicable" (29%) or that they did not know how satisfied they were with the energy audit (26%) and did not rate the satisfaction. The high level of "don't know" and "not applicable" responses could be due to a number of possibilities including poor communication between the contractors and the stalled participants, some of the survey respondents not being present when the audits were conducted, or even that some energy audits were not completed. Of the 45% of stalled participants who that did rate their satisfaction with the audit process, the average satisfaction rating was 4.59, indicating they were satisfied with it. Those who remembered energy efficiency improvements rated the DI measures and their overall experience with the program higher than those that did not. This might be the case because they associate the work they received more with the program than the others. One of the four people who were less than satisfied with the energy audit reported it was because the audit did not teach them anything new. The others did not provide reasons why.

Over one-third (36%) of the stalled participants did not rate the satisfaction with DI measures. Of those that gave a 1 to 5 rating, the mean was 4.49. Those who recalled energy efficiency improvements recommended in the audit report had a statistically higher satisfaction with the direct install than those who did not (4.82 to 4.29). They also had much lower levels of "not applicable" and "don't know" responses. Those stalled participants less than satisfied with the measures, mentioned the measures they received broke and/or were low quality. One said that the contractor messed up their floor during the installs.

The average satisfaction rating of the stalled participant for the contractor who did the DI measures was 4.73 for the 65% who gave a satisfaction rating. The two who were less than satisfied said it was either because their contractor did not tell them a lot of information or because they did not remember the contractor very well.

Seventy-nine percent of the stalled participants who said they did not recall any energy efficiency improvements recommended in the audit report, also replied "don't know" or "not applicable" when asked about the satisfaction with the audit report with suggested measures. Of those that recalled them, they gave an average of 4.00. The overall average for those that gave numbers was 4.18. Of the seven that were less than satisfied with the audit report, four said they did not recall the report, two said they did not get any suggestions they were not already aware of, two wanted more information on next steps (such as finding contractors), and one respondent did not have the measures that he/she wanted to do.

When asked about satisfaction with the program staff, 36% of the stalled participants gave a "don't know" (13%) or "not applicable" (23%) response. The mean satisfaction rating for those that gave a 1 to 5 response was 4.76. There was some higher satisfaction with the program staff when some or all of the utility bills were included in the tenant rent. One reason given for not being satisfied was a lack of assistance received from the program staff.

We also asked the stalled participants about their suggestions for improving the program. Over half (61%) had no suggestions (Figure 36). The most common suggestions were to use better quality light bulbs, do more follow-up/quicker follow-up after the program, and use better quality appliances. One suggestion was to switch from CFLs to LEDs, which the program has already done in 2015. This response and others related to lighting quality (some participants view LEDs as higher quality bulbs than CFLs due to better performance capabilities of LEDs) suggest that new program offerings like LEDs might attract some of the stalled participants back into the program.

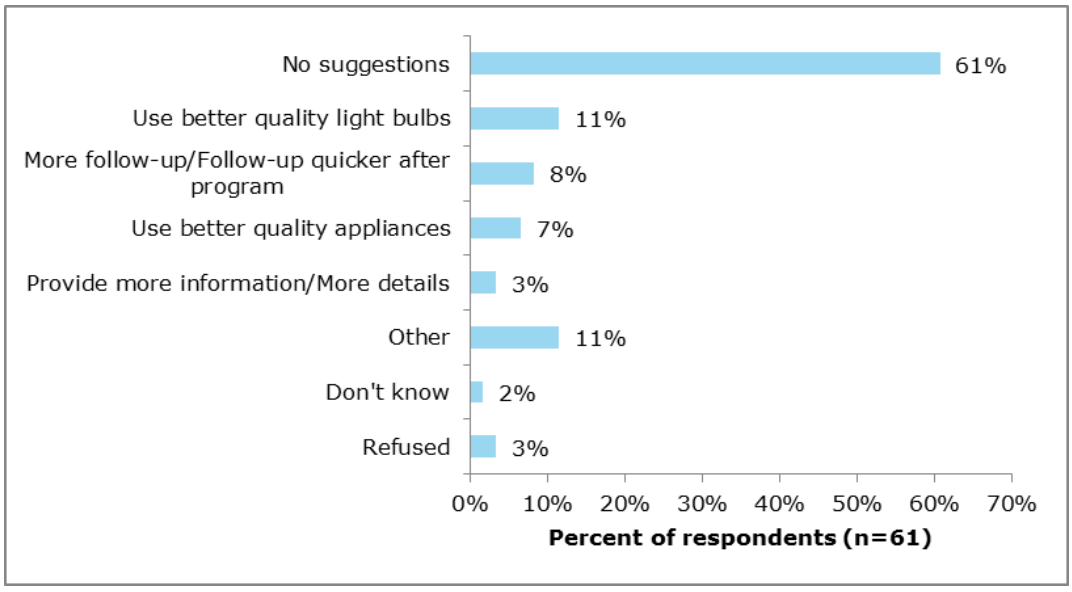

Figure 36: Suggestions for improving the program

Note: The total will add to more than 100% as respondents could give multiple responses to this question.

APPENDIX E. FULL PARTICIPANT SURVEY RESULTS

Firmographics

When we asked the full participants where they worked, the large majority (72%) said they work onsite at the property. The others reported they work in a corporate office (10%) or are the owners of the condo they live in (14%). In condominiums, each condo owner is a separate decision-maker and they work directly with the contractors in the program as individual participants. This is not the case in apartments, where we only consider the property manager to be the participant.

When we asked the full participants for their job title, the large majority (74%) reported being some type of manager (Figure 37). Fourteen percent reported they were the condo owner, and 4% identified themselves as the property owner.

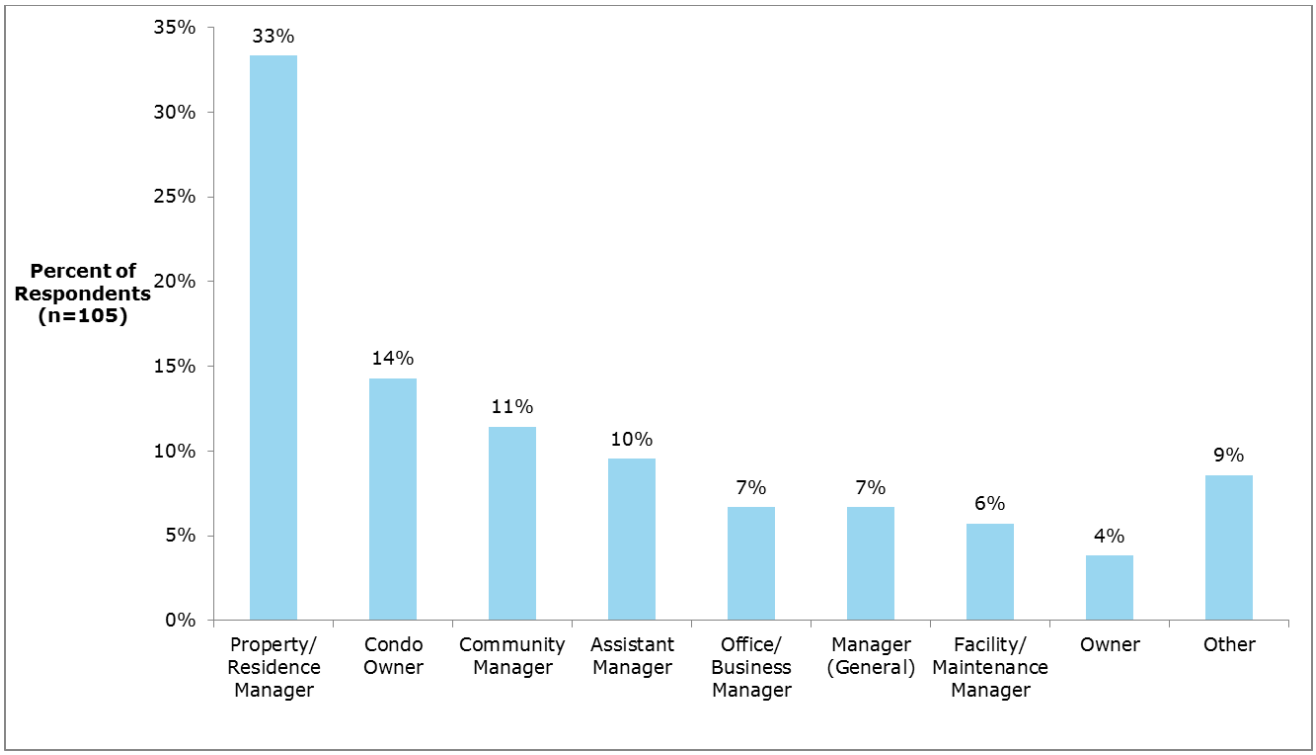

Figure 37: Respondent job title

The majority of full participants reported that they own (58%) or partially own (10%) their property, while only 9% reported renting. Others reported that they just manage the building. Seventy-six percent of respondents reported their company was located in Washington, with 27% reporting being in Seattle. As Figure 38 shows, younger buildings (<36 years old) were more likely to be owned by companies located outside of Washington, than older buildings (36+ years old).

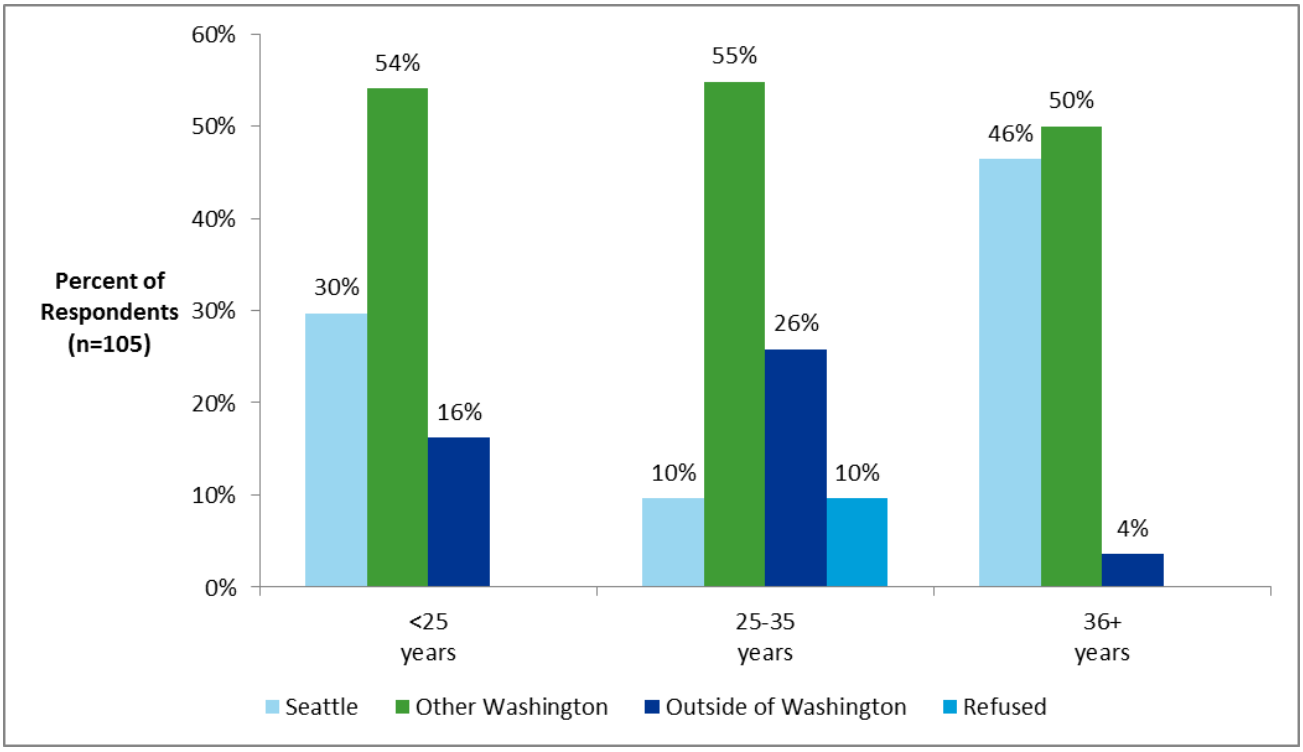

Figure 38: Location of property management company by age of property

We asked the full participants when their properties were built. Over half (53%) of the respondents reported construction dates from 1980 to 1999. Sixty-three percent of respondents said their property was an apartment building, while 24% said it was a condominium. The remainder said it was a combination of both. Those who said they managed more than 25 properties tended to manage apartment buildings (74%), while those who reported managing fewer than 25 properties had a higher percentage of condominiums (40%) (Figure 39). Fourteen percent of respondents reported being an individual condo owner, which may be the cause of this difference. As reported by PSE staff during DNV GL's in-depth interviews, the program has been targeting condos since they were previously underserved. According to the PSE staff interviews, 14% of multifamily homes in PSE's service territory are condominiums, so a 24% penetration in 2014 is a success.

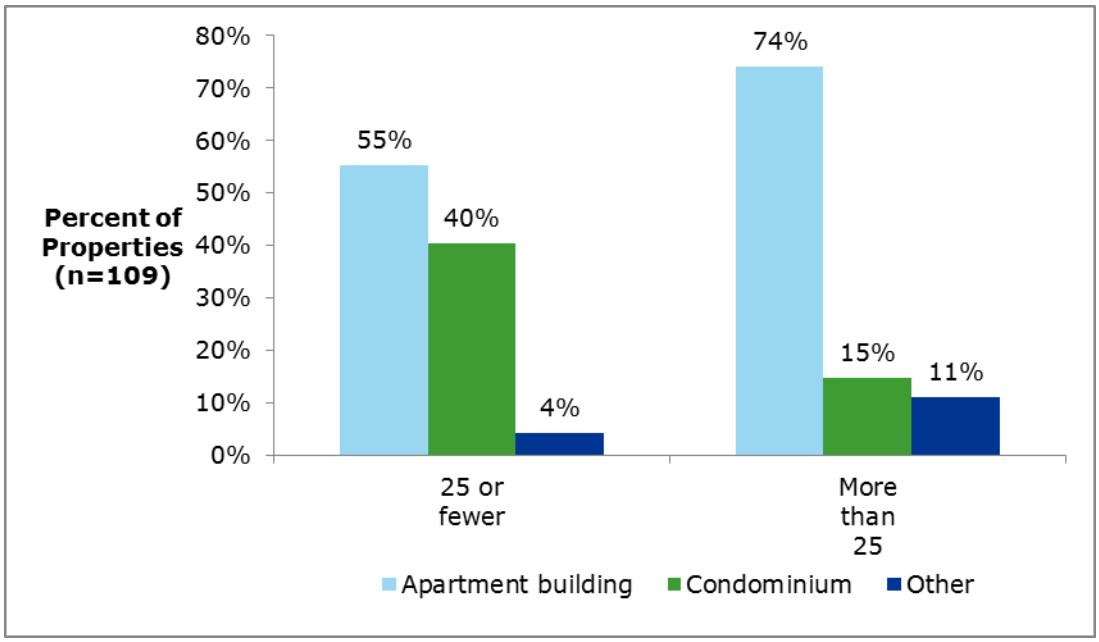

Figure 39: Property type by number of properties managed

We asked the full participants how many properties they managed. The respondents reported a range of one property managed per company to 1,000 properties per company. The average number of properties managed by a company was 57 and the median was 9. In general, the respondents associated the newer properties with larger management companies, although the difference was not statistically significant. The average number of tenant units per property they reported was 100. The number of reported tenant units per property was higher for properties 35 years old and younger than it was for those over 35 years old.

We asked the full participants to report the general income levels of tenants in their property. Property representatives reported that one-fifth of the properties had mostly middle income tenants, with 38% of properties being reported as being either somewhat or very diverse in terms of the income base of its tenants (Figure 40). Respondents reported that 15% of the properties had mostly low-income tenants.

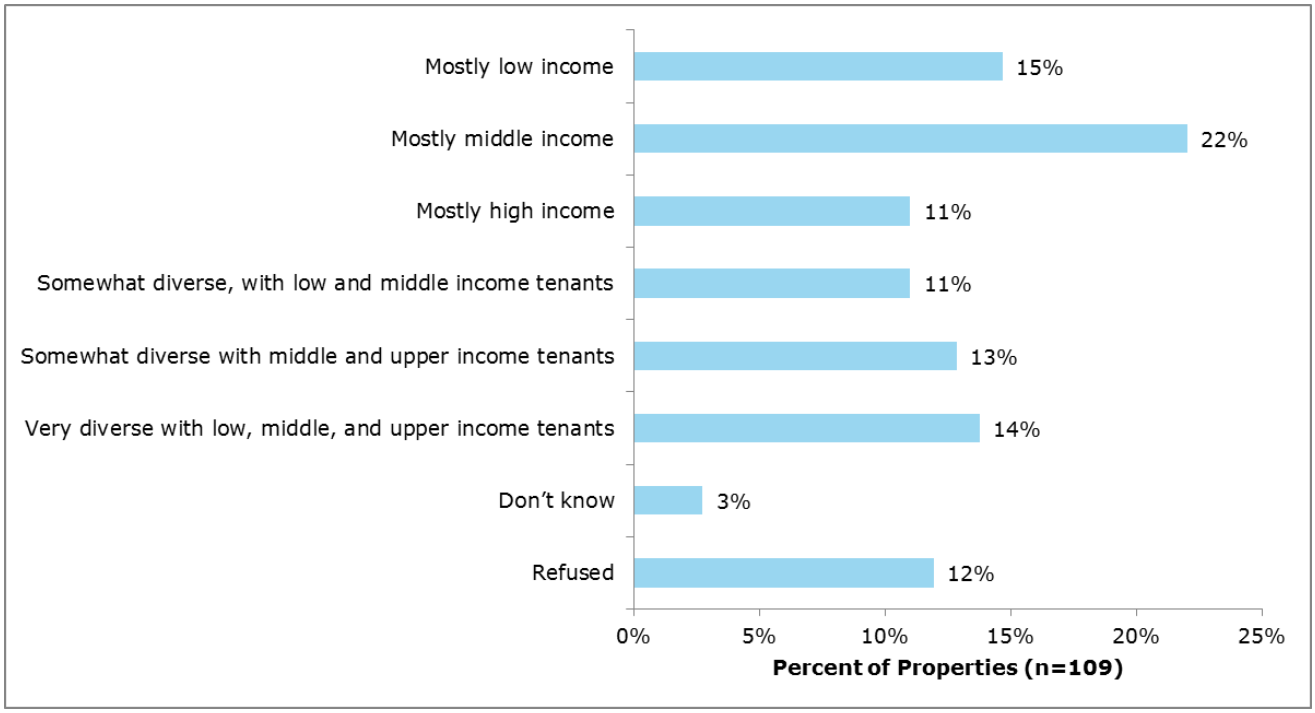

Figure 40: Income characterization of stalled participant properties

We asked the full participants whether their tenants paid their own utility bills. As shown in Figure 41, the managers representing the majority (68%) of the properties said that their tenants pay their own bills.[25] Managers representing 88% of properties said that their properties were individually metered for electricity. Those representing 50% of the properties which had gas service (74% of respondents reported they had no natural gas in their property) said that their properties were individually metered for natural gas. The managers also reported that 83% of properties had individual heating systems and 25% had individual cooling systems. According to the managers' responses, 61% of properties had no cooling system at all.

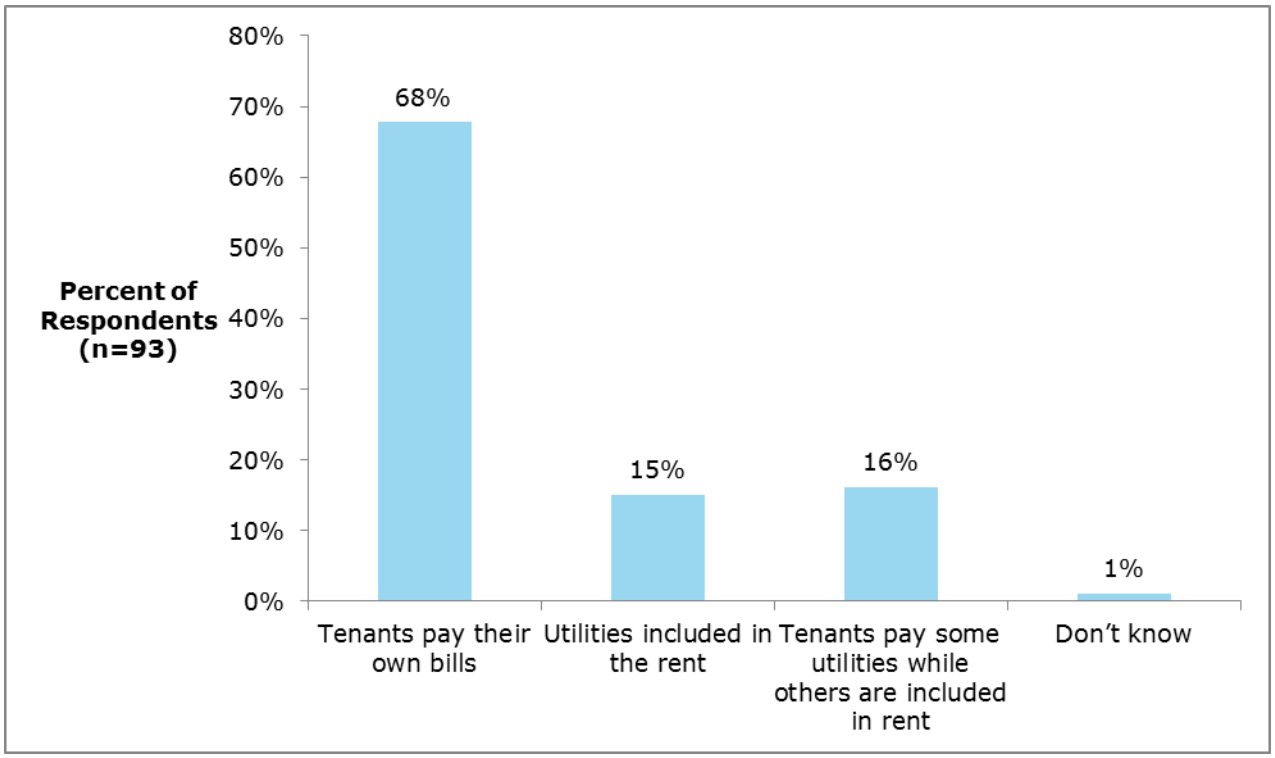

Figure 41: Tenant responsibility for paying utilities[26]

[25] Only participants that work for the property were asked these questions. Condo owners were not asked as it pertains to all units, not just theirs.
[26] We did not ask this question to condo owners.

Program awareness and services received

The full participants reported that, in general, when purchasing or replacing energy-using equipment, they used online research (32%) and internal company resources (32%) to help make a decision on which equipment to purchase (Figure 42). Respondents who said that they managed more than 25 properties said they relied more heavily on contractor recommendations (22%), while those with 25 or fewer properties were more likely to mention asking a colleague or friend (17%). This shows a potential difference in management style based on company size. Managing more properties may increase contractor connections and also decrease the amount of time available to research options; both of these reasons increase reliance on contractor recommendations. In addition, contractors are more likely to target larger multifamily properties because it allows them to take advantage of economies of scale. In contrast, smaller properties may not have those relationships with contractors and may have to rely more on colleagues or friends for assistance.

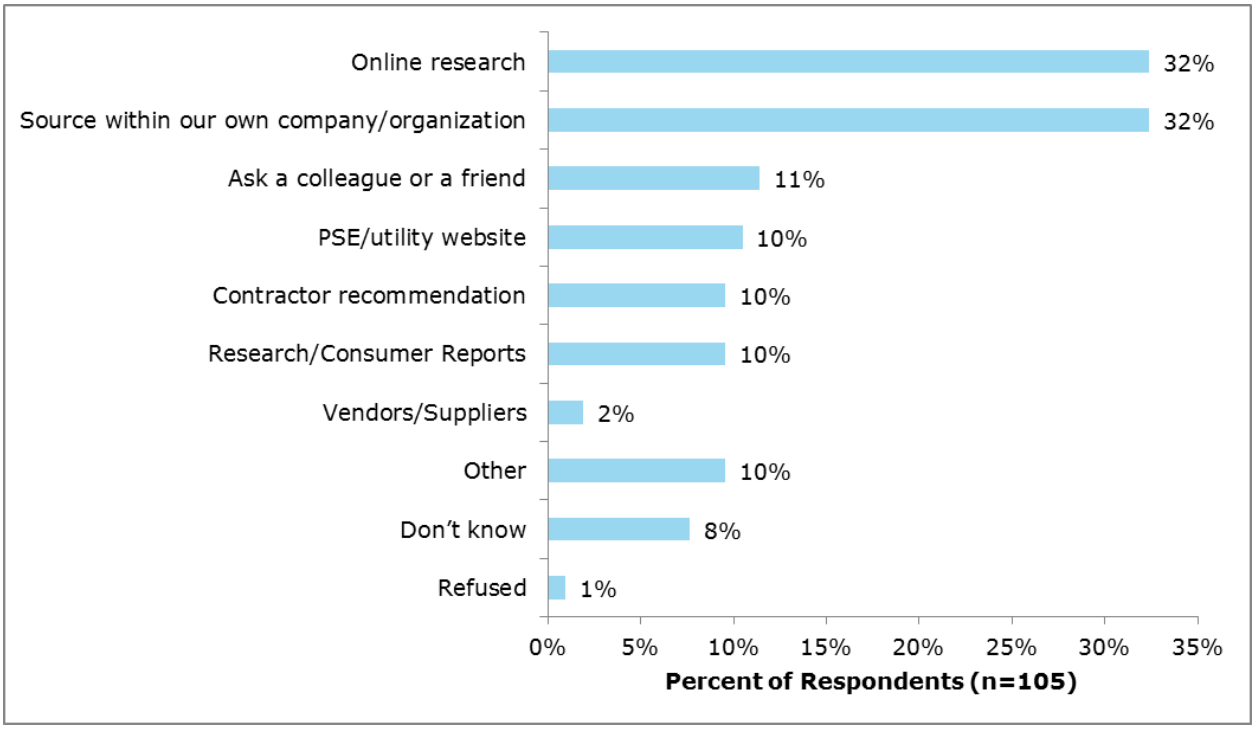

Figure 42: Sources of information used to help make a decision on new energy-using equipment

The top two methods mentioned by the full participants for how they first became aware of the program were from the PSE/utility website (23%) and by word of mouth (23%). Figure 43 shows all the methods mentioned by respondents. Four of the top five ways participants found out about the program were related to personal contact: word of mouth, a colleague recommending it, a contractor contacting the participant, and PSE visiting/calling about the program. This shows the importance of personal contact in driving participation in this program.

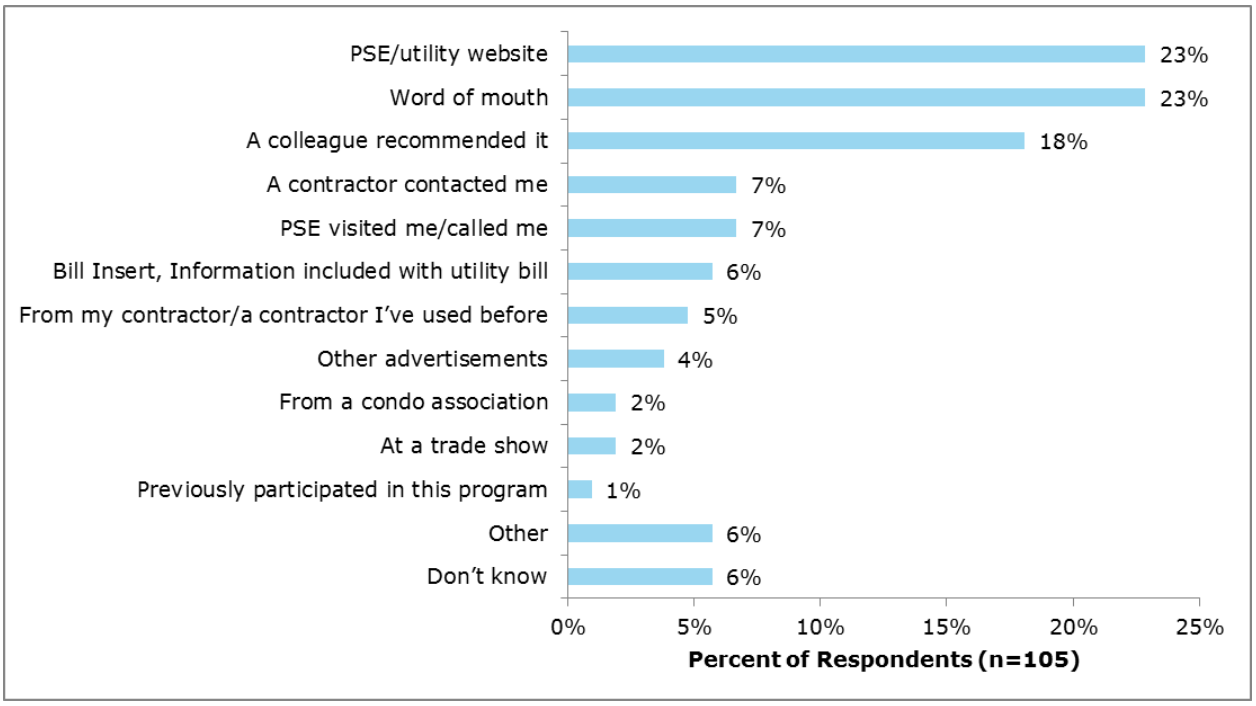

Figure 43: How participants became aware of the program
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

We asked the full participants why they decided to participate in the program. The most common response for why respondents participated in the program was reducing utility bills/saving energy (63%). As shown in Figure 44, other common reasons for participating included equipment upgrades (25%) and for environmental reasons (24%). The top reason shows the importance of providing information on the cost benefits to potential participants. Additionally equipment upgrades being the second highest option indicates, that PSE's program may have a strong presence in getting people to install more efficient equipment when they are replacing aging equipment.

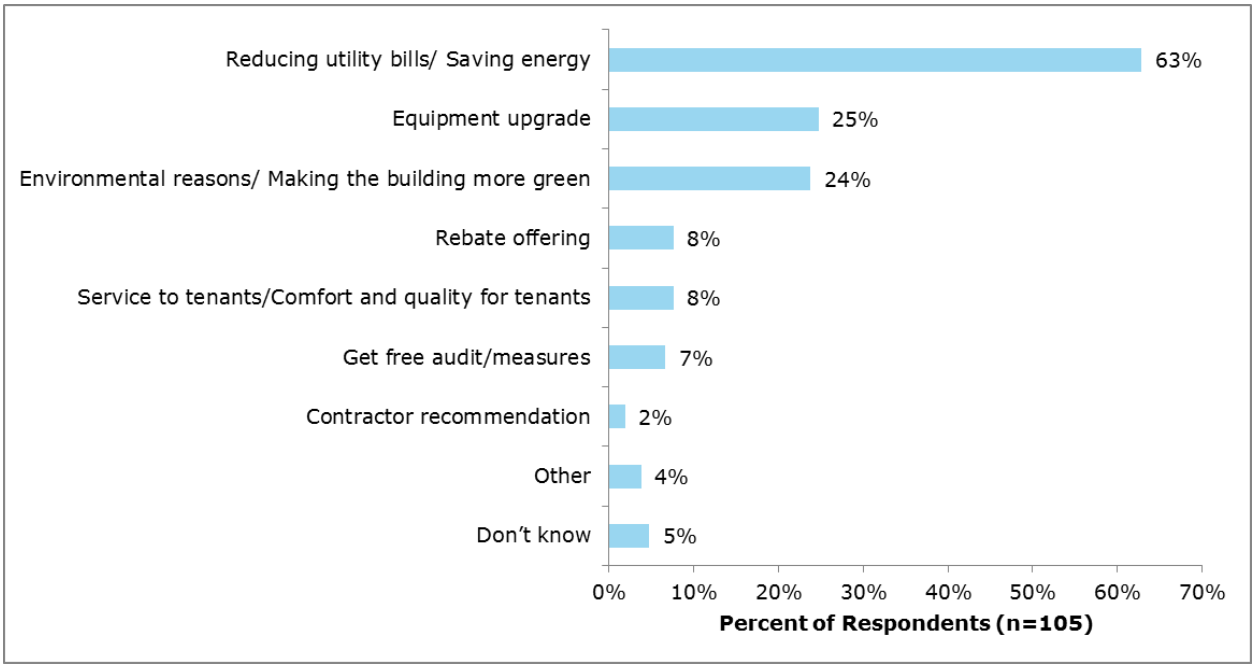

Figure 44: Reasons for participating in the program
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

We asked participants what barriers they had to overcome to participate in the program. Most participants (62%) reported they faced no barriers to participating in this program (Figure 45). For those that faced barriers, the most common barriers mentioned were related to stakeholder issues (working with tenants for access, obtaining agreement from the community/owners), the time and effort involved (paperwork/red tape, time involved), and the costs (overall costs and upfront costs). We also interviewed program actors about their perceived barriers for customer participation, and they also mentioned these same key themes. Working to mitigate these barriers could help increase overall participation rates.

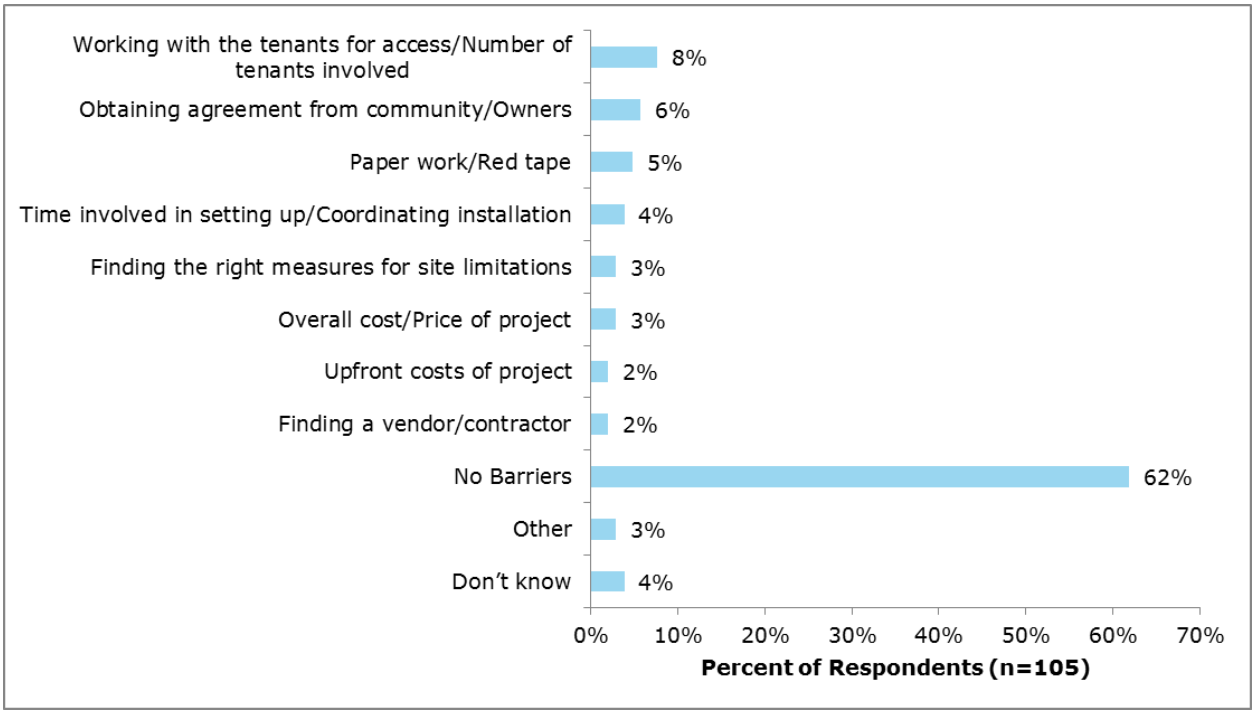

Figure 45: Barriers participants had to overcome to participate in the program
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

Figure 46 shows the full participants' 'awareness of the program services they received. The highest level of recall was for the DI measures (79%). Properties with low-income tenants had a significantly higher reported level of recall of DI measures (88%) compared with properties without low-income tenants (73%). This could indicate that properties with low-income tenants are more likely to have outdated and inefficient equipment or that property managers try to get them more services. Another possibility is that these low-income properties are receiving direct installations from multiple programs (including those with more a low-income focus).

While recall for DI measures was high, the data files only reported 47% of respondents receiving DI measures. This could indicate an issue in the tracking data or confusion about what is considered in a DI measure.

About half of the full participants remembered receiving an energy audit, suggestions for energy efficiency improvements, and rebates. We would expect to see higher recall of rebates since these were an important aspect of program participation. Lower recall could indicate that contractors are getting the rebates themselves and just passing on the cost savings to the customer. Respondents who reported managing 25 or fewer properties were more likely to remember receiving rebates (66%) compared with those with more than 25 properties (37%). The lower level of rebate recall among respondents with the higher volumes of properties is most likely due to them belonging to large property management companies where there may be other recipients of the rebates (e.g., administrative, accounting departments). Another possibility is that since those that manage more than 25 properties earlier cited using contractor recommendations more frequently to make decisions, they may be less likely to recall the rebate because it went to the contractor and they received instead a line item discount on the contractor's bill.

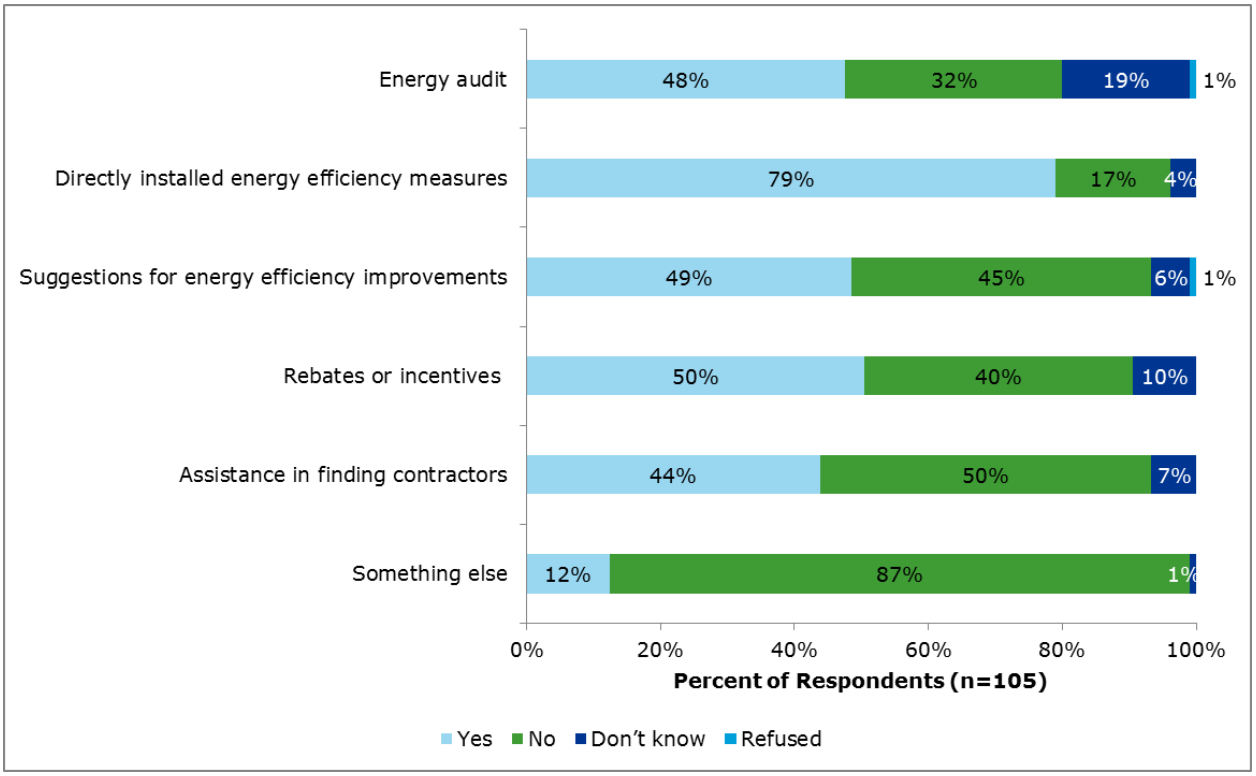

Figure 46: Participant recall on services received as part of program

We asked the full participants how they heard about the contractors they used to install the rebated measures. Over half of respondents (58%) reported they heard about their contractor through PSE's contractor alliance network. The next highest response (16%) was from a contractor they had used before. Figure 47 shows other ways people found out about the contractor. This demonstrates the usefulness of the contractor alliance network for helping respondents find contractors.

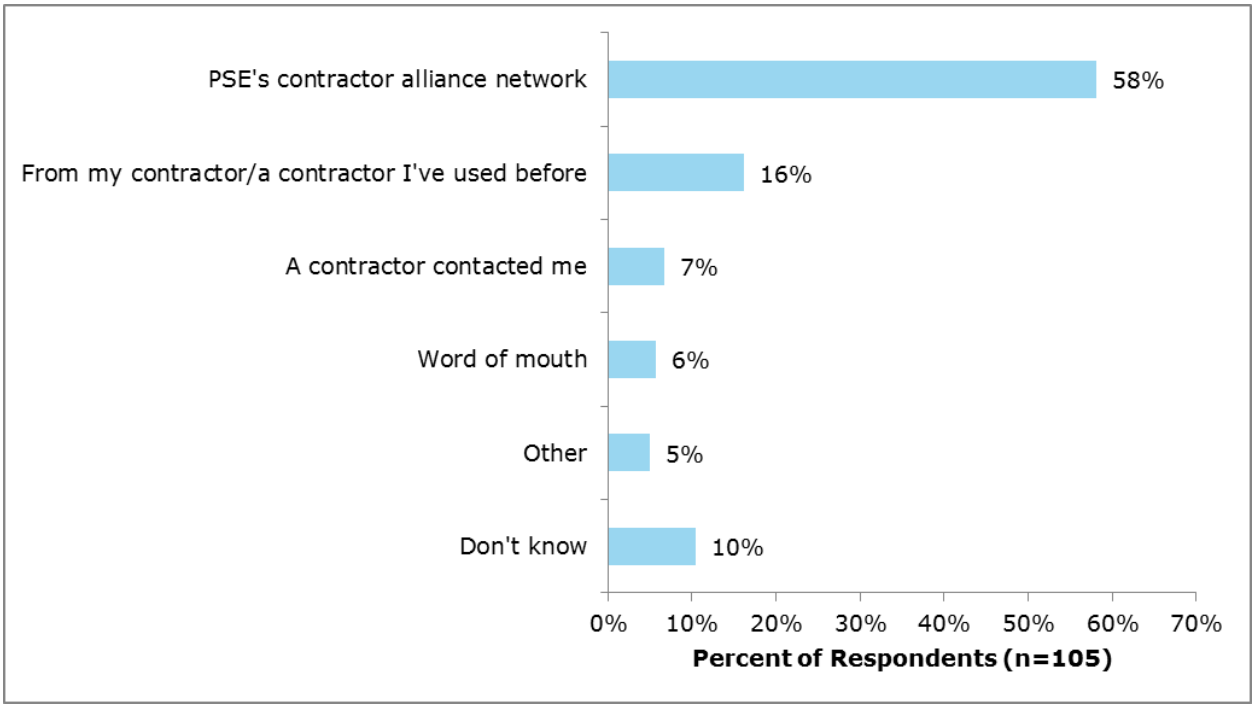

Figure 47: How participants heard about the contractor(s) who installed rebated measures

Note: The total will add to more than 100% as respondents could give multiple responses to this question.

We asked the full participants if they were aware of the other types of energy efficient equipment that PSE's multifamily retrofit program offered (besides the ones that they received). About one-third said they were aware of some of the other options (Figure 48). Those who recalled receiving a rebate through the program were also more likely to know about other rebate options (55% versus 17%). When asked what measures they were aware of, the top answers were in-unit refrigerator (29%), in-unit clothes washer (21%), insulation (21%), and LED fixtures (21%). When we asked full participants who said they were aware of additional rebates reported why they did not take advantage of these additional rebates, the most common responses were because they did not need that equipment (21%), they were not eligible for it (13%), or they had financial limitations (11%). As seen earlier in the survey, financial barriers do still prevent participants from installing all the measures.

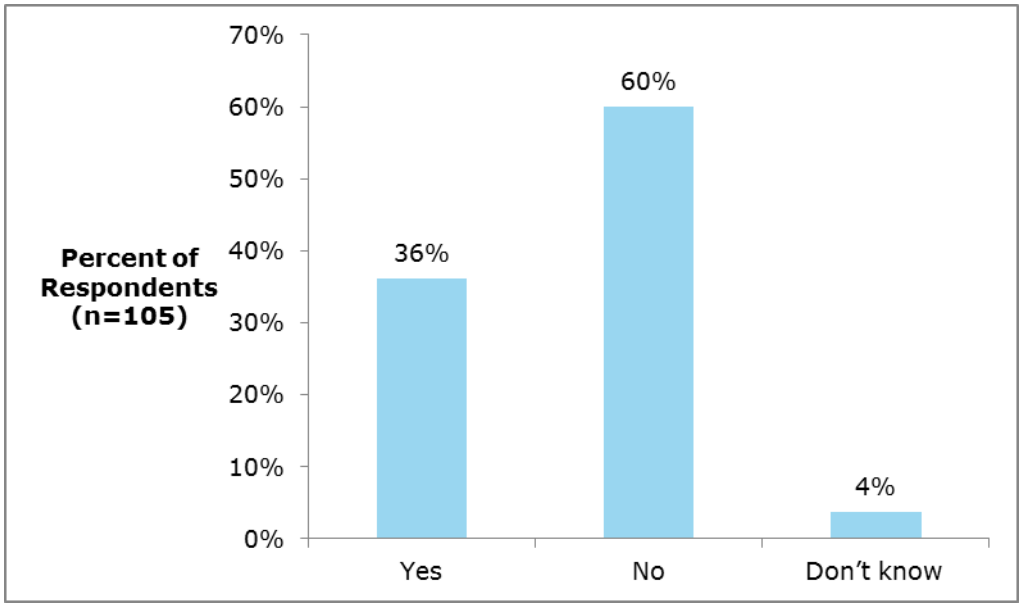

Figure 48: Participants aware of other rebates offered through the program

The survey asked the full participants about their preferred method of contact if PSE were to provide them with more information about rebates and other program services. The large majority (71%) of respondents cited email as their most preferred method of contact. The second and third most-cited preferences were in the mail, separate from the bill (28%) and as a bill insert (15%). Figure 49 provides the full range of responses.

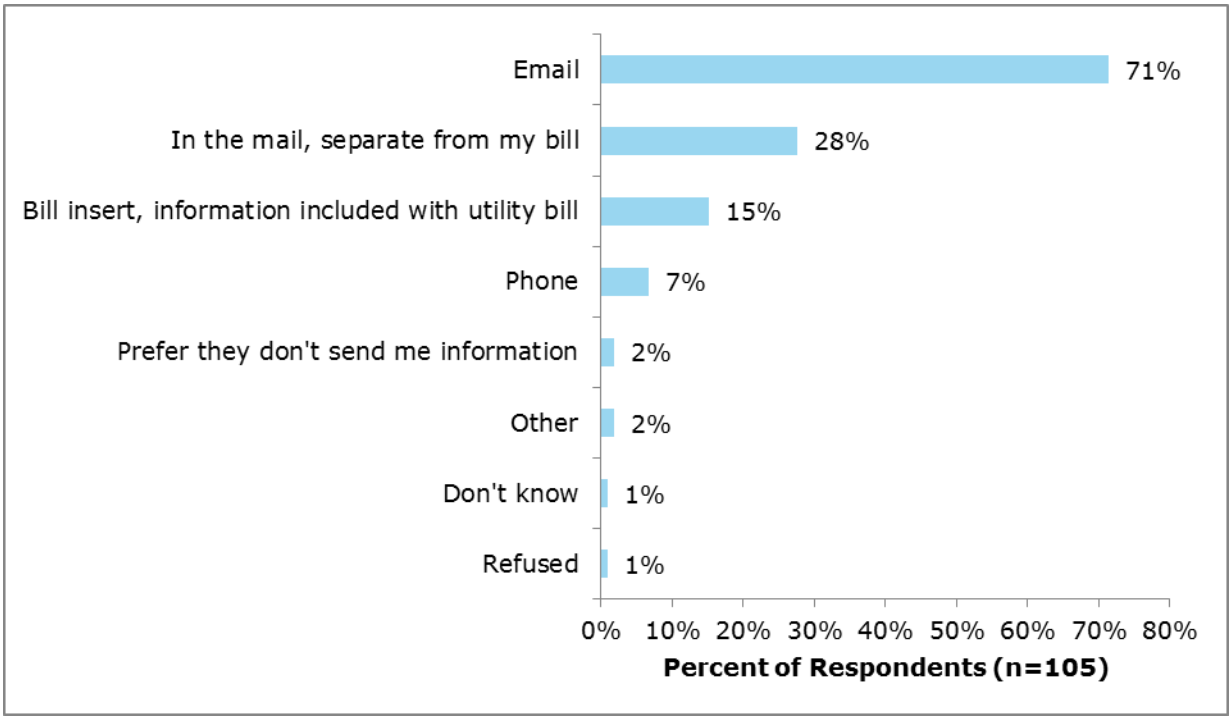

Figure 49: Preferred method of contact to hear about other rebates and program services
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

Program satisfaction

The survey asked the full participants about their satisfaction with various aspects of the program. We asked respondents to rate each aspect on a scale from 1 to 5, where 1 was very unsatisfied and 5 was very satisfied. Figure 50 shows the mean level of satisfaction for those who gave a numeric response (other accepted responses were "don't know", "refuse to answer", and "not applicable").

As the figure shows, the average satisfaction rating across all aspects of the program was both high and consistent, ranging from 4.51 on the rebate application form to 4.62 on the energy audit. The average satisfaction rating for the overall program experience was 4.59. Ninety percent of respondents gave a 4 or 5 on the scale. Only 3% gave a "don't know" or "not applicable" response. The 8% of participants who were less than satisfied with the overall program mentioned dissatisfaction with the performance of the equipment, the contractor, the information sharing in the program, and the energy savings.

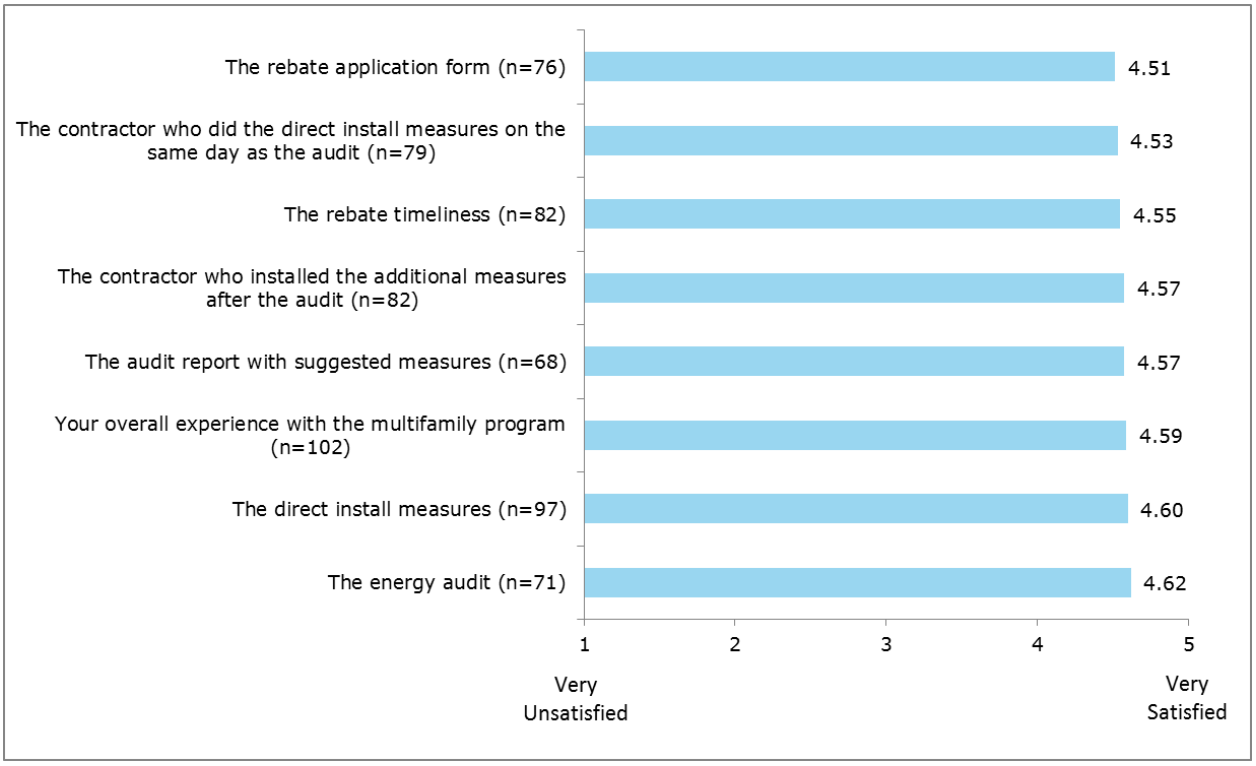

Figure 50: Average satisfaction with program aspects

Additional information on the full participants' levels of dissatisfaction with various program attributes as well as reasons for this dissatisfaction (Table 25). The percentage of full participants who felt familiar enough with the program attributes to provide satisfaction ratings ranged from a high of 92% for the DI measures to a low 67% for the audit and audit . For most program attributes the percentage of respondents willing to provide satisfaction ratings was in the 75%-78% range.

Table 25: Participant dissatisfaction and reasons for dissatisfaction

Attribute of Program	% Less Than Satisfied	Reasons for Dissatisfaction
Audit, Audit Report	6%	• They did not get any new suggestions • The report did not have the measures the respondent wanted to do • The report did not have enough information on next steps • They did not receive the report
Direct Install Measures	11%	• Installed equipment being low quality/breaking • The installation taking too long
Direct Install Contractors	10%	• The contractor being unprofessional, • The contractor being messy or breaking something • The contractor showing up late
Contractors installing program-rebated measures	8%	• The contractor being unprofessional, • The contractor being messy or breaking something • The contractor showing up late
Rebate application forms	7%	Rebate form was difficult to complete
Rebate timeliness	8%	• Rebate took too long • Never received the rebate

Table 26 shows the percent of participants who responded to the different satisfaction questions as well as the percent that were satisfied and dissatisfied with the various components of the program.

Table 26: Participant satisfaction response rate and reasons for dissatisfaction

Attribute of Program	% Providing Satisfaction Rating	% Satisfied (of those providing ratings)	% Less than Satisfied (of those providing ratings)	Reasons for Dissatisfaction
Audit, Audit Report	67%	94%	6%	• They did not get any new suggestions • The report did not have the measures the respondent wanted to do • The report did not have enough information on next steps • They did not receive the report
Direct Install Measures	92%	89%	11%	• Installed equipment being low quality/breaking • The installation taking too long
Direct Install Contractors	75%	90%	10%	• The contractor being unprofessional, • The contractor being messy or breaking something • The contractor showing up late
Contractors Installing Program-rebated Measures	78%	92%	8%	• The contractor being unprofessional, • The contractor being messy or breaking something • The contractor showing up late
Rebate Application forms	77%	93%	7%	Rebate form was difficult to complete
Rebate Timeliness	78%	92%	8%	• Rebate took too long • Never received the rebate

We also asked the full participants what the program did well. Their most frequent responses were about communication between the program staff and the respondents including good communication/being responsive to questions (20%), good information/education on program (18%) and good customer service in general (15%). Figure 51 shows the full range of responses.

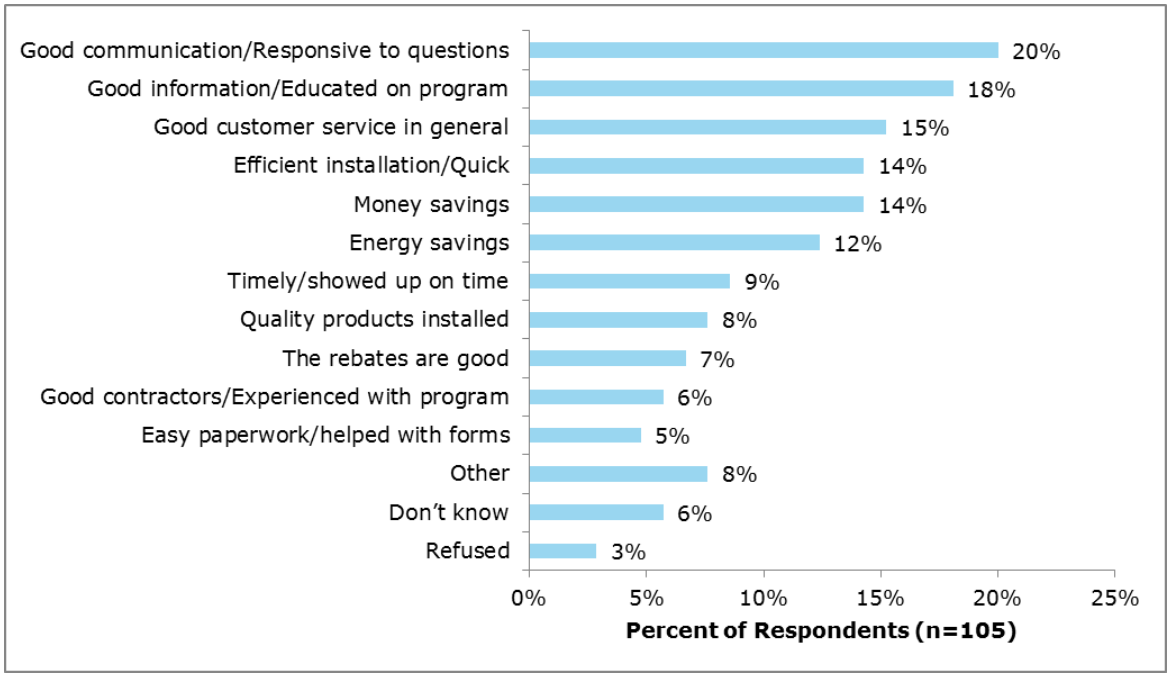

Figure 51: What respondents believe the program does well
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

Once the full participants had a chance to say what the program does well, the survey asked them what suggestions they had to improve the program. The top suggestions included expanding the program to cover more equipment or property types, simplifying the rebate process, providing more information about the program, and using better quality products (Figure 52). Over half the respondents said they had no suggestions.

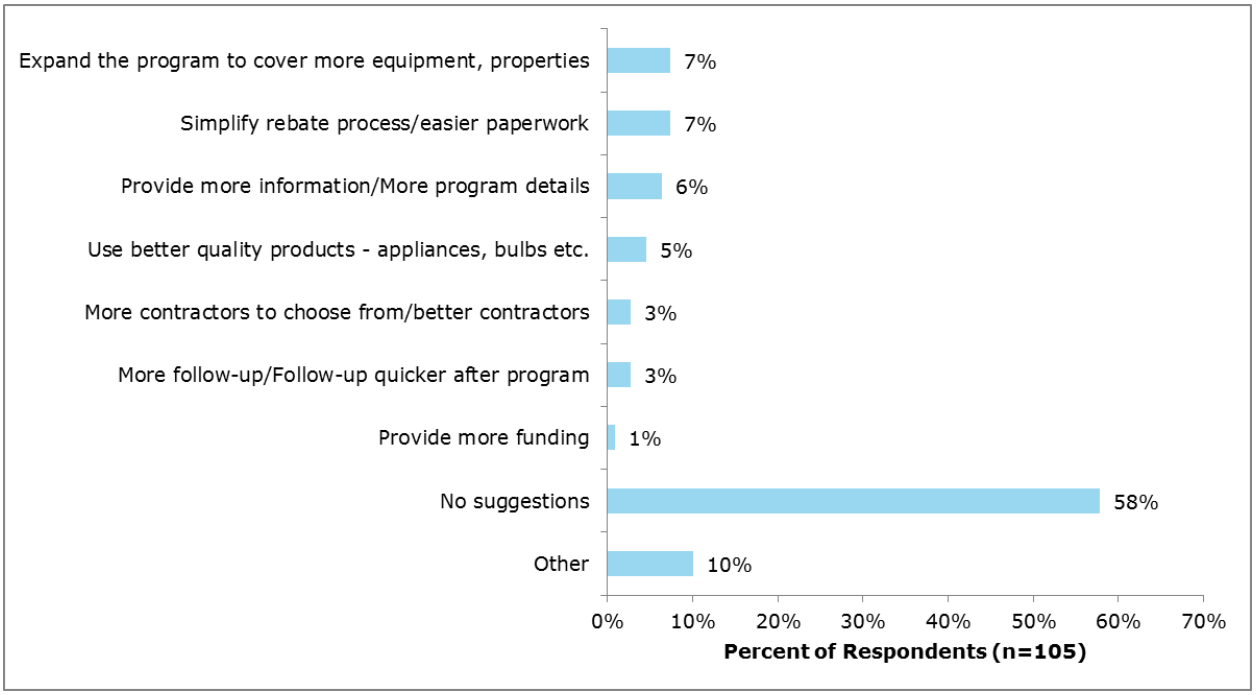

Figure 52: Respondent suggestions for improving the program
Note: The total will add to more than 100% as respondents could give multiple responses to this question.

Program influence and like spillover

In addition to asking about their experience with the program, the survey also asked participants about how much the program influenced them, both in terms of the measures they installed through the program as well as measures they installed after they participated in the program. This section will not quantitatively assess free-ridership and spillover, but it will discuss it qualitatively. Free-ridership assesses what a person would have done in the absence of the program; someone who would not have done anything without the program was 100% influenced by the program and is not a free-rider. Someone who would have done all the same things without the program is 100% a free-rider, meaning the program gave them a rebate, but did not influence their action. More often than not, people fall somewhere in the middle, where they might have installed the same equipment, but not as soon as they did, or they did more than they would have done without the rebate.

One indicator of program influence is whether the program contributed to the conception and scope of the project. We asked the full participants who came up with the idea for the energy efficiency improvements at their property. Over half of respondents (54%) indicated that the idea to do energy efficiency improvements on their property came from the organization's internal management team (Figure 53). In 21% of responses, the idea for energy efficiency was due to the program, either coming directly from the contractor, or from the program energy audit. In 14% of cases, the respondents equally credited their organization and PSE and/or the contractor for coming up with the idea.

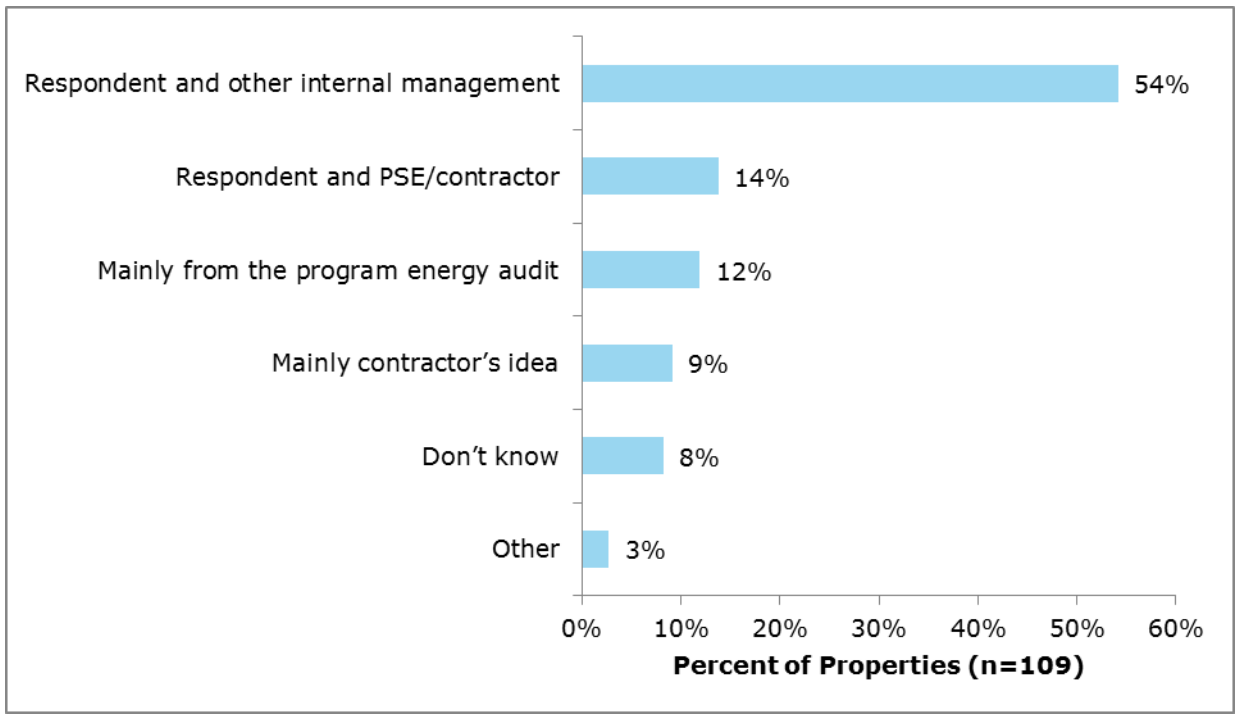

Figure 53: Who came up with the idea for the energy efficiency improvements at the property

We also asked the full participants if the program had helped them identify energy efficiency opportunities that they had previously been unaware of. Sixty-one percent of respondents indicated that the program had helped them identify such opportunities. Those who indicated high levels of satisfaction with all aspects of the program were significantly more likely to have said the program helped them identify new energy efficiency opportunities (81%) than those who were less than satisfied with at least one aspect of the program (51%) (Figure 54).[27] This suggests that audits are an important component of the program. It also indicates that smaller, less sophisticated multifamily property companies are likely to be the most appreciative of the program since they are unlikely to have the internal resources to do such audits on their own and their smaller size makes them less attractive to energy efficiency contractors.

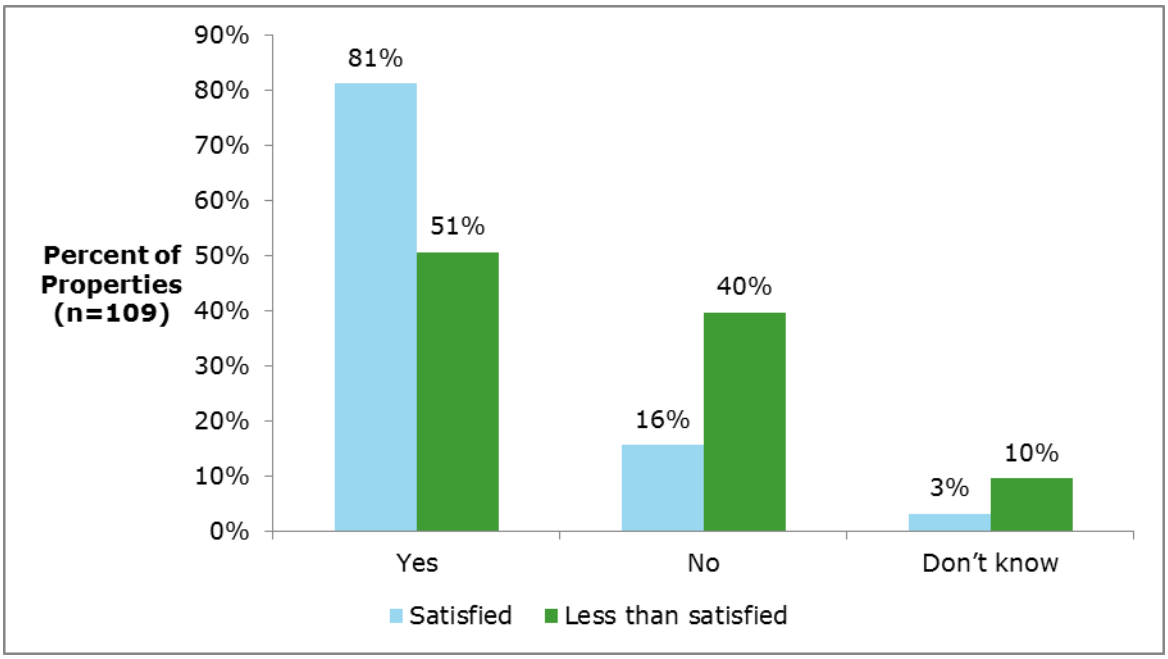

Figure 54: If the program helped identify energy efficiency opportunities the property management had previously been unaware of, by program satisfaction

[27] The analysis considered respondents as satisfied with the program if they gave a 4 or a 5 for all aspects of the program on a one to five scale, where 1 is very dissatisfied and 5 is very satisfied. If a respondent gave a 3 or below on any aspect of the program, the analysis considered them less than satisfied with the program.

The survey asked respondents how likely they would have been to get an energy audit without the PSE program. Twenty-eight percent of them said they would have been "very likely" to get an audit without the program with another 29% saying they were "somewhat likely" to get the audit without the program. Figure 55 shows the full range of responses.

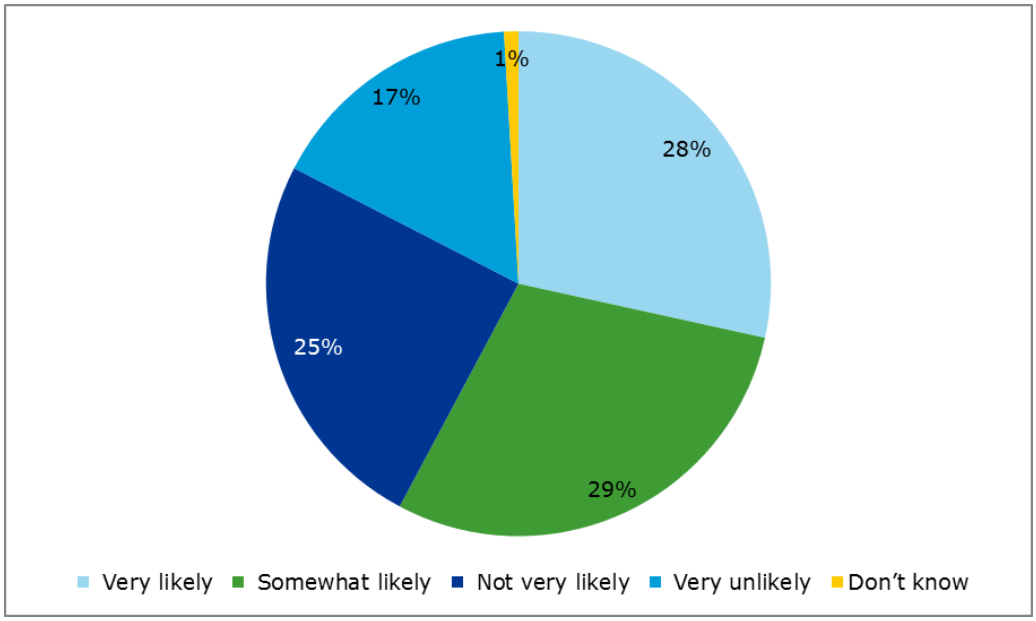

Figure 55: Likelihood of getting an energy audit without participating in the program (n=109)

About half of respondents said that they received DI measures as part of their participation (47%). The survey asked these respondents how likely they would have been to purchase and install these DI measures (which included measures such as LED light bulbs and faucet aerators) without the program. Only 12% said that they were "very likely" to purchase and install these measures without the program although a third of them said they were "somewhat likely" to do so. Figure 56 shows all the responses.

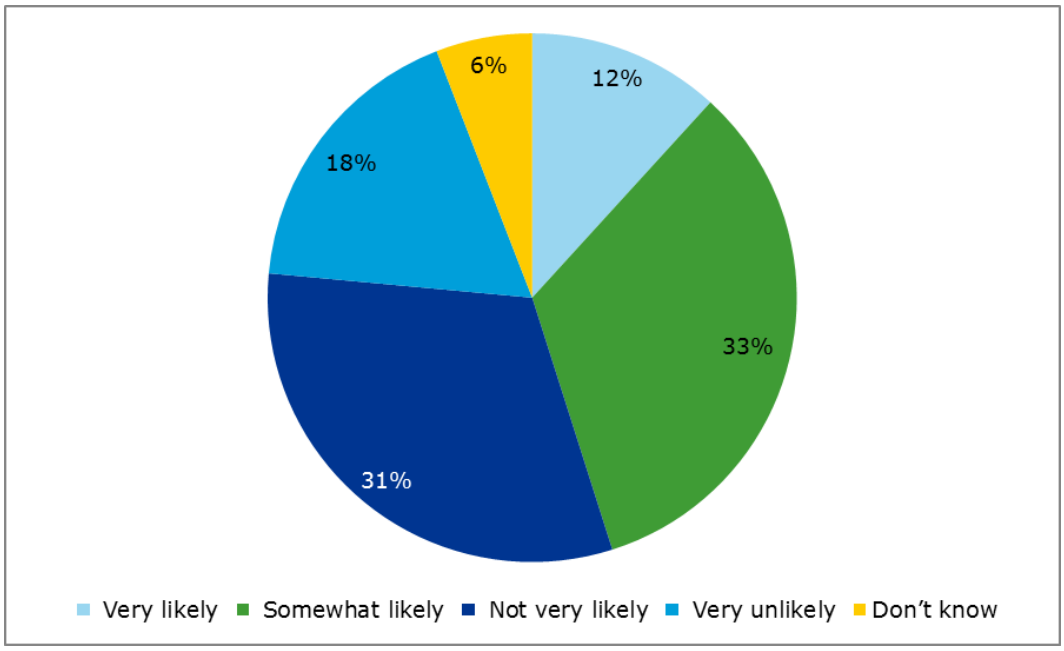

Figure 56: Likelihood of installing DI measures without the energy audit for respondents who received DI measures in the tracking data (n=51)

We asked the full participants who had indicated that they would have been "very likely" or "somewhat likely" to have installed the measures a series of questions about the likelihood of installing each measure individually. Figure 57 combines the responses to the two questions to show the reported likelihood of installing each DI measure (we coded those who said "not very likely" or "very unlikely" to the first question above as "no" in the figure below). LEDs were the measures that the respondents were most likely to say that they had installed without the program's assistance, with 25% of them reporting that they would have been "likely" or "very likely" to have installed LED lights without the program. Only 8% of respondents said the same about advanced power strips. Overall, the majority of respondents said they would have been unlikely to install the various DI measures without the program, indicating that the program influenced them to take these actions.

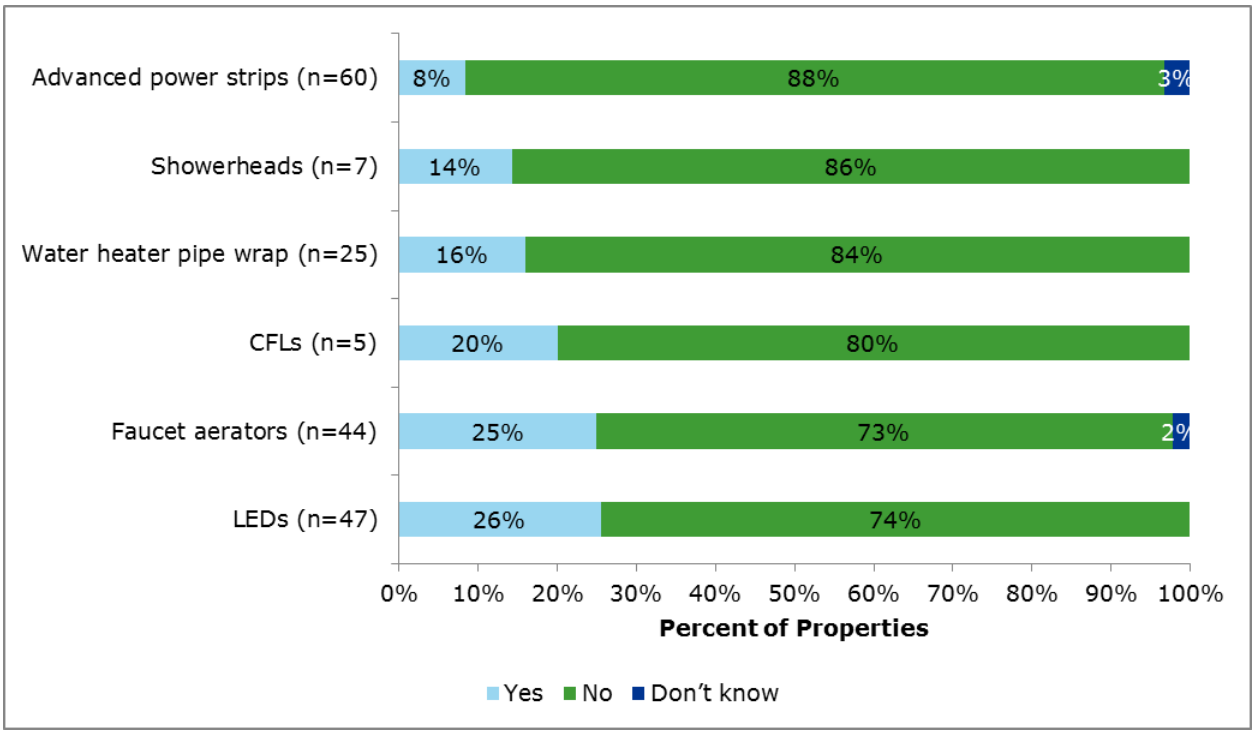

Figure 57: If participants that received DI measures through the program would have been "very likely" or "likely" to have installed this measure on their own

The survey asked the full participants the likelihood of installing each of the rebated measures both without the energy audit and then without the program. As shown in Figure 58, the frequency of responses did not shift much when asked about the likelihood of installing the rebated measures without the program as opposed to without the energy audit. The program seemed to have a slightly greater influence than the energy audit, with 35% of respondents saying they were "very unlikely" to have installed the measures without the program compared with 29% without the audit. The program would receive full savings credit for those who reported they would have been very unlikely to install the measures without the energy audit or the program.

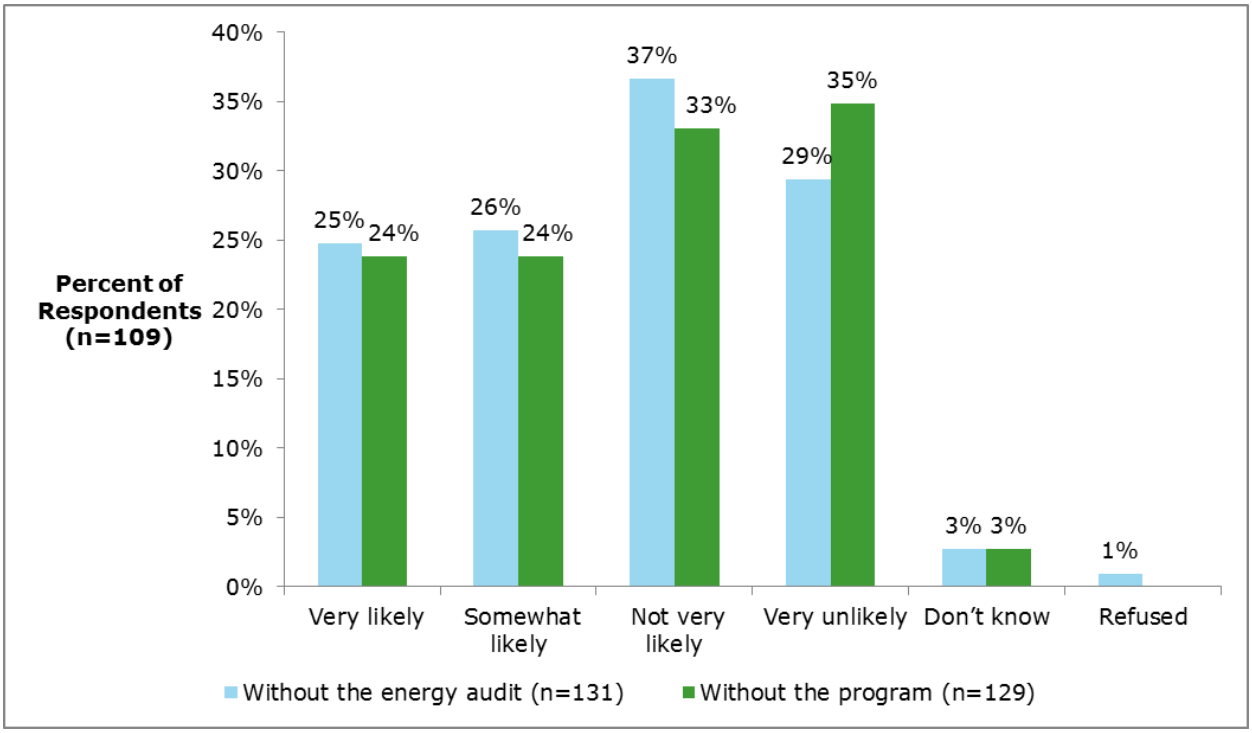

Figure 58 : Likelihood of respondents installing the rebated measure without the energy audit or the program

We did not ask those full participants who indicated they were "very unlikely" to install the rebated measures without the energy audit or program any more of the influence questions. Yet we did ask the remaining respondents about the likelihood of their installing the measures without the contractor. We did this because sometimes participants may attribute influence to their contractor rather than the program not realizing that the program may have influenced the contractors to promote more energy-efficient products. Sixty-four percent of the respondents reported they were "very likely" or "somewhat likely" to have installed the measures without the contractor (Figure 59).

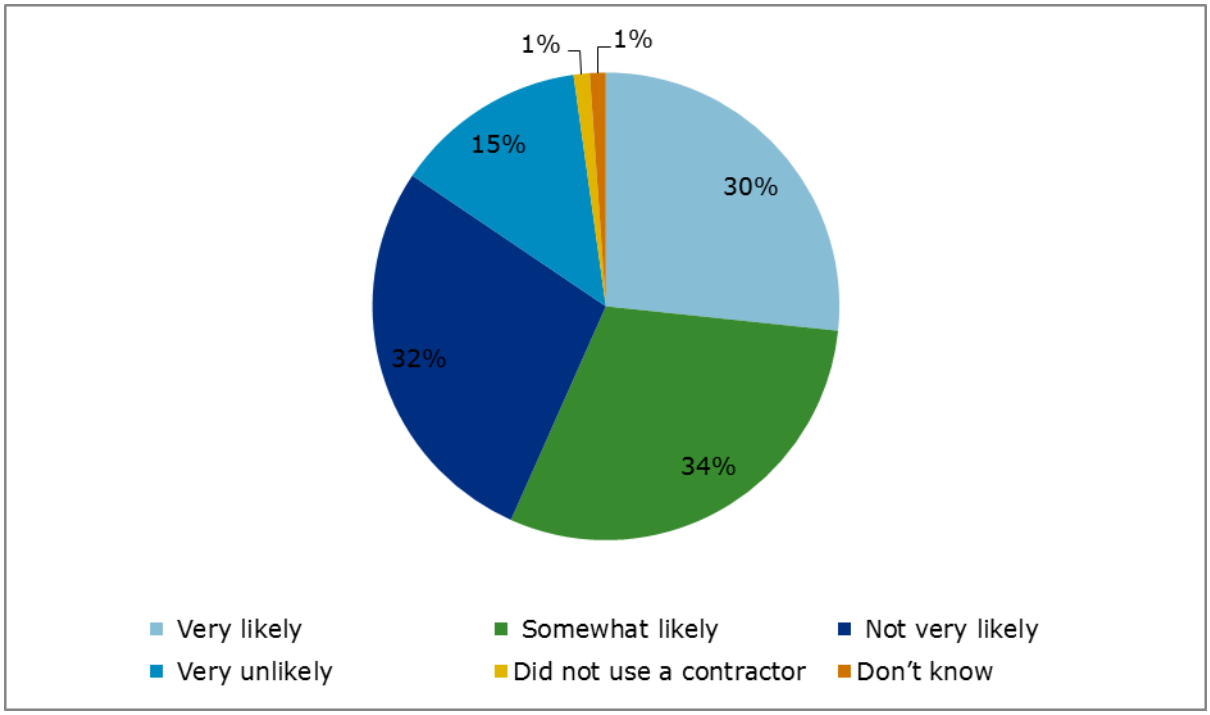

Figure 59: Likelihood of installing the measure without the contractor for respondents who were not "very unlikely" to get the measures without the program (n=90)

The full participants also answered questions about energy efficient actions they had taken since participating in the program. Sixteen percent of respondents reported that they had installed energy efficient equipment that had been recommended by the program audit but they had not applied for a program rebate for these measures (Figure 60). The most common measure which respondents reported that they installed without the receipt of a rebate was a LED fixture. Other items they mentioned included other efficient lighting types, in-unit refrigerators, in-unit clothes washers, windows and sliding glass doors, and a heat pump water heater.

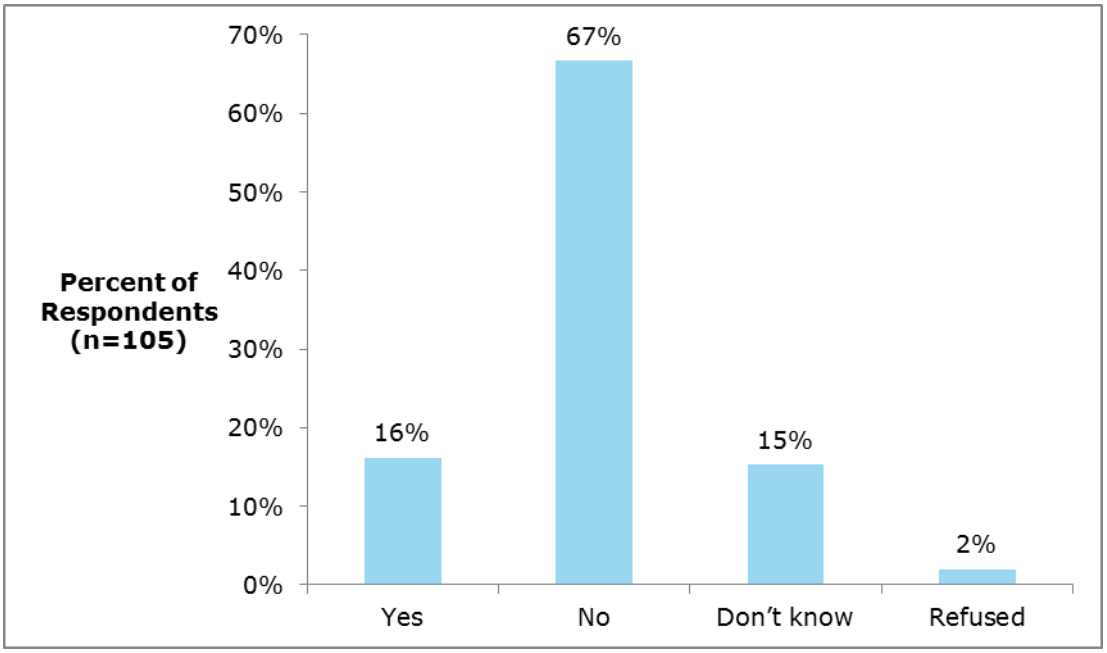

Figure 60: Respondents who installed recommended measures after the program that they have not received a rebate for

Seventeen percent of the respondents said they had plans to install additional audit recommendations but they had not gotten to these yet (Figure 61). The measures which they most frequently reported as planned but not yet installed included insulation, LED fixtures, and common area lighting. Other measures included in-unit refrigerators, in-unit clothes washers, windows and sliding glass doors, and a heat pump water heater.

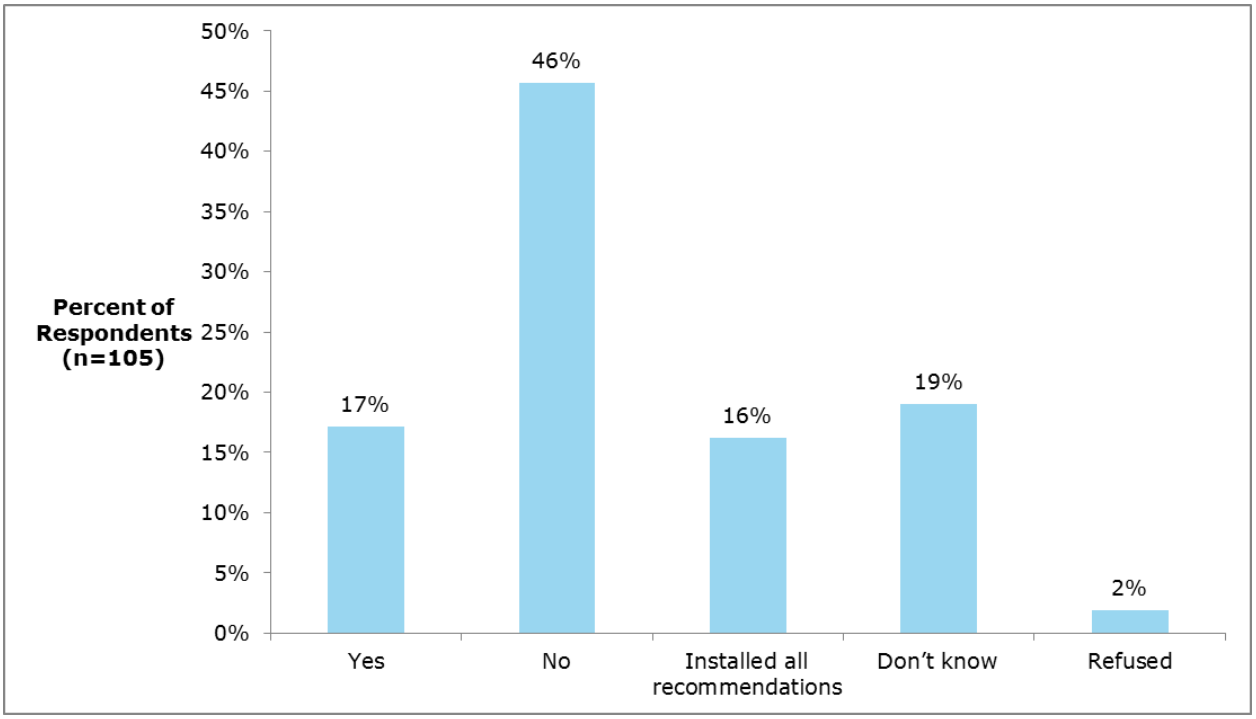

Figure 61: Respondents who plan to install recommended measures in the future

We asked the full participants whether there were recommended measures which they did not plan to install. Only 4% of respondents mentioned there was a recommended measure that they did not plan to install (Figure 62). The measures they mentioned were LED fixtures, common area lighting, insulation, and windows and sliding glass doors. Three of the four respondents cited financial limitations as the reason they did not plan to install these measures. The other respondent said they were only replacing equipment on an as-needed basis (i.e. at time of replacement). As discussed earlier in this report, lack of capital has been reported by multiple stakeholders and by multiple participants and continues to be the largest barrier discussed across the different survey questions.

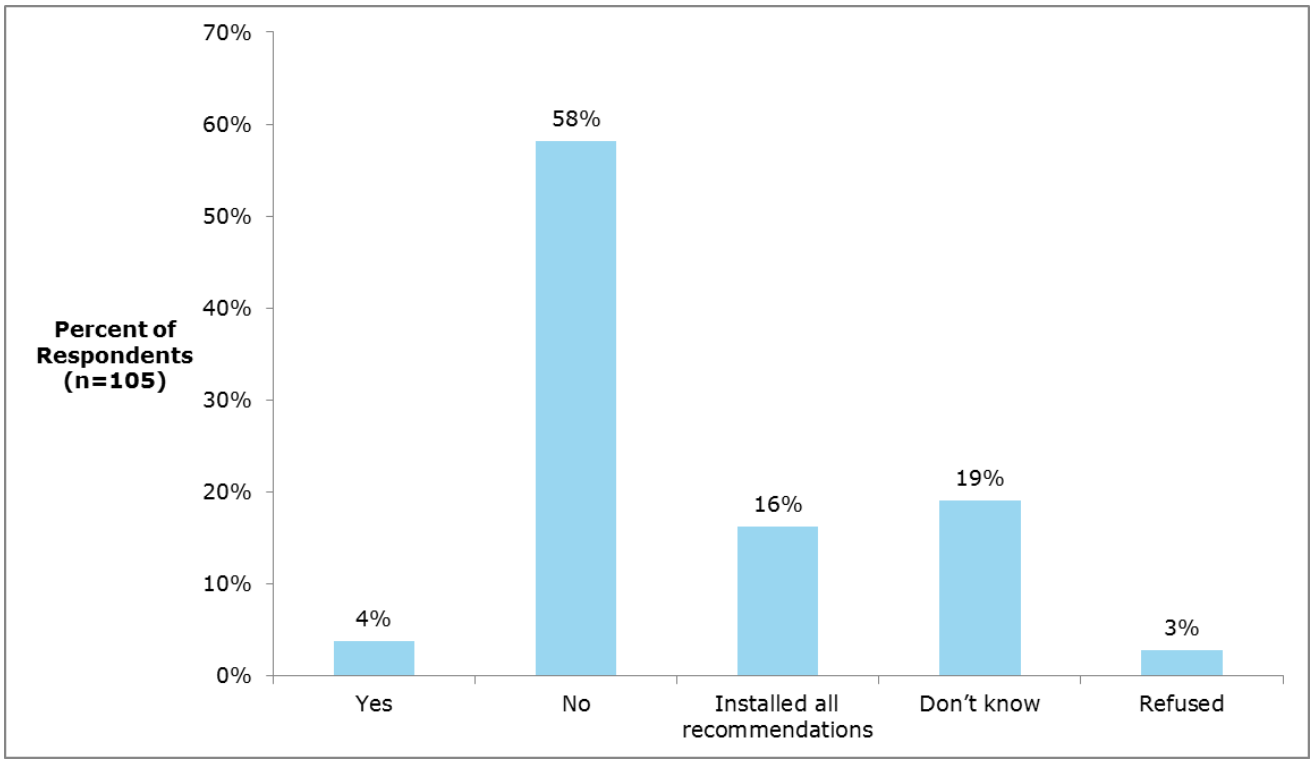

Figure 62: Respondents who did not plan to install recommended measures

We asked respondents whether they installed any measures that were not recommended by the program. [28] Nine percent of the respondents asked reported they implemented energy efficiency improvements that were not recommended by the program (Figure 63). Some of the measures they did included getting higher efficiency lighting (including LEDs), better windows, heat pumps, low-flow showerheads, low-flow toilets, and aerators.

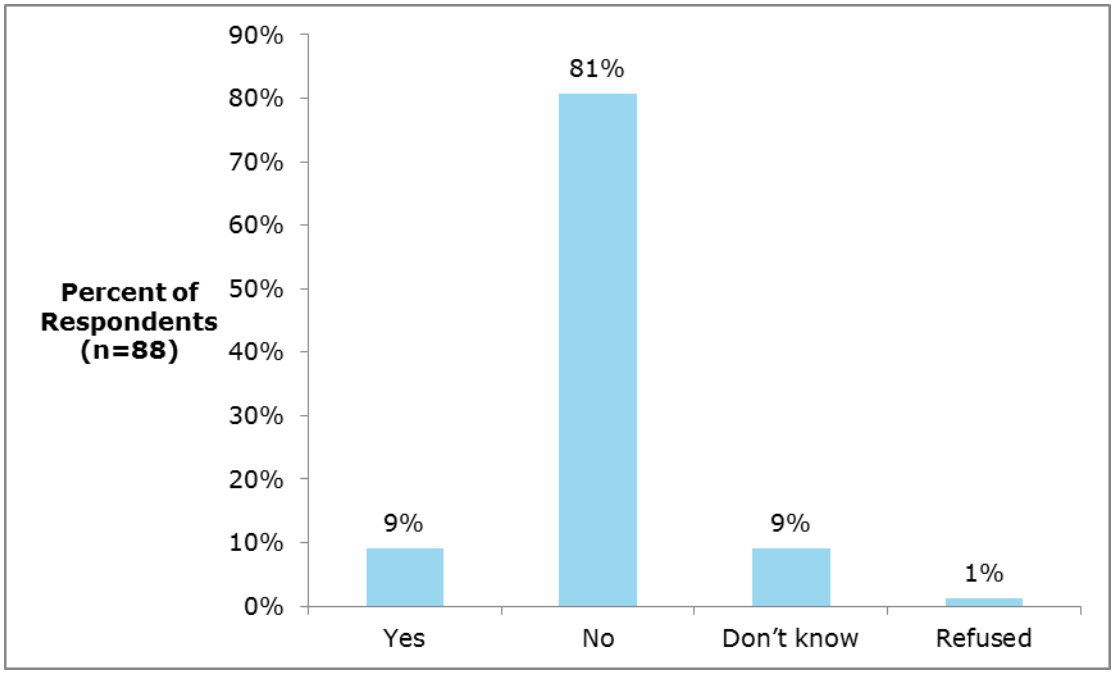

Figure 63: Respondents who have installed energy efficiency measures not recommended by the program

[28] In the survey we skipped those who said they installed all program-recommended measures past this question. In hindsight we should have not skipped these respondents because just because they installed all the program-recommended measures does not mean they could not have also installed some energy-efficient measures which were not installed by the program.

About DNV GL

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PUGET SOUND ENERGY

Evaluation Report Response

Evaluation Report Response

Program:	Multifamily Retrofit
Program Manager:	John Forde
Study Report Name:	2012-2013 Multifamily Retrofit Program Impact and Process Evaluation
Report Date:	December, 2015
Evaluation Analyst:	Jim Perich-Anderson
Date of ERR:	January 19, 2016

Evaluation Overview, Key Findings, Recommendations and Program Responses:

Overview:

This evaluation report documents the results of the impact and process evaluation of the PSE 2012-2013 Multifamily Retrofit Program. This program is designed to increase the installation of selected cost-effective energy efficiency measures in existing multifamily buildings with five or more attached dwelling units. It provides free energy audits of multifamily buildings to help building owners, operators, and tenants better understand energy consumption and energy savings opportunities. Depending on the results of the energy audit, the program directly installed no-cost measures (e.g., showerheads) as well as provided incentives for more complex upgrades (e.g., windows). The program also provided energy efficient power strips as a leave-behind measure.

The study's goals were to verify measure installations, quantify program level energy savings, collect feedback from participants, and survey stalled participants, defined as those who went no further in the program than just receiving the energy audit and direct-install (DI) measures. DNV GL developed the following as part of the process and impact evaluations of the 2012-2013 program:

- Statistically representative savings analysis sample
- Program document and database review
- Onsite surveys
- Multifamily buildings energy consumption models
- Program savings realization rate
- Program staff interviews
- Logic model development
- Participant and stalled participant computer-assisted telephone interviews (CATI)

Key Findings:

Impact Evaluation –

- The analysis yielded an electric gross-savings realization rate of 86% and a gas gross-savings realization rate of 77% (evaluation report, page 2). The sampling precision of the evaluated (ex-post) savings estimate at 90% confidence is 15% for the electric savings and 22% for the gas savings (p. 1).
- Realization rates were significantly affected by lower-than-expected persistence of direct install measures. Approximately two-thirds of installed lighting, which consisted of compact fluorescent lamps (CFLs) and light-emitting diodes (LEDs), remained in place two to three years after installation. This is much lower than the assumed measure life of each.
- Power strips, which were provided as a leave-behind measure, were found to have the lowest installation rate of any measure at 13%.

Process Evaluation –

- The stalled participants have positive attitudes towards energy efficiency, but financial and non-behavioral barriers affect participation.
- The large majority of the stalled participant respondents only had very limited authority for project approval.
- Many recent participants are not recalling the program rebates, which could negatively impact program attribution.

Impact Evaluation Recommendations and Program Responses

The evaluation was looking back at the program as implemented in 2012 and 2013. Several of the report's impact and process recommendations were implemented in the 2014-2015 program cycle. The program team strives to ensure that the program is operating at a high level of efficiency and maximizes all opportunities to improve. Still, there are ample opportunities to improve the customer interactions, track & report savings and program outreach/education. As the team plans & implements the 2016-17 program we will address the evaluation report's additional recommendations. This section presents the specific recommendations made in the evaluation report, and program responses.

'1. Direct installation and leave-behind measures do not have 100% persistence. For planning purposes, including cost-effectiveness analysis, the program should assume that a portion of measures directly installed by the program either fail or are removed by tenants before the end of their useful lives (p. 9)'.

Program Response: All 2016-17 direct install measures are now RTF deemed with the exception of faucet aerators. Measure takeaway, breakage & removal are taken into account when determining savings by the RTF.

To further address measure persistence, we will work closely with the property managers to determine which measures they want PSE to install. We will continue to provide leave-behind information in each residence to inform the residents of the energy savings value of the measures and request that, if they move out, they leave the measures in their homes, as they are property of the building owners.

'2. Assume an appropriate attrition rate for "plug" measures such as power strips. Appliance and water fixture measures generally are left in place in tenant units, while measures that are plugged in can be easily removed by the property owner or tenant. The program may be able to use follow-up communications to address the issue where measures were left to the property manager and were never installed (p. 9)'.

Program Response: All plug measures (power strips) were left in the residents' units during installation along with other directly installed measures. We do not leave equipment with the property managers as we

are unsure if they will install them and report back to PSE that they were in fact installed. The power strips delivered in 2012/13 during the direct install process were primarily Tier 1 strips. Installations may have been less intuitive to the residents. The power strips we plan to install in 2016 are simpler to install and are Bluetooth enabled. When the resident installs the strip, they can enable a Bluetooth connection via smart phone and PSE can identify that the strip was installed. This will allow PSE to track installations. Additional capabilities allow the residents to track energy savings from the power strips, on their smart phones.

'3. Combine program tracking database and project file data. The program tracking data from the 2012-13 program was done at the site level while the project details, including where (i.e. tenant units) the measures are installed, are kept in separate disconnected files. Expanding the tracking database to include all of the relevant project level info would provide additional sample points for evaluations, allow for more reporting options, and ultimately help PSE better understand their program. Upon receipt of the draft report, PSE informed DNV GL that this issue is being addressed with the implementation of energy Orbit operations platform (p. 9)'

Program Response: Confirming the statement above, past & current program data has been recently incorporated into our vendor maintained Energy Orbit platform. This allows the team to analyze data, identify missed energy savings opportunities and engage customers with new measures. PSE has complete access to the database.

Process Evaluation Recommendations

'1. The stalled participants have positive attitudes towards energy efficiency. The survey revealed that a large majority of the stalled participants thought that energy efficiency was important. This should allow the program to focus more on overcoming financial and other non-behavioral barriers to energy efficiency implementation.

The [lack of a significant] split-incentive barrier among this stalled participant group should make it easier for the program to encourage action. *(p. 9)'*

Program Response: The program now offers information on financial services on our web site. Several banks offer loans to multifamily property owners. Also, in our interactions with owners and managers we discuss non energy benefits so they understand the additional benefits. These include noise reduction, better indoor air quality, comfort, reduced mildew on windows and other benefits

'3. There may be opportunities to work with appliance supply contractors. Over a third (36%) of the stalled participants said they did have a contractor they used more frequently and nearly half (48%) of these mentioned HD Supply as their frequent contractor. When we asked the respondents what services they used these specific contractors for, they most frequently reported using them to get appliances (44%) and maintenance supplies (40%). So if the program is not already working with HD Supply and other similar contractors, these survey results indicate that there is a real opportunity there for measures such as refrigerators.'

Program Response: HD Supply is only an equipment supplier and does not install energy efficiency measures. They are strictly a supplier of many products to multifamily housing owners. In the past, we tried to work with HD Supply to have them identify and provide energy efficient equipment to properties in the PSE service area. We found that their business model was not capable of tracking and invoicing only PSE service area installations and they were delivering energy efficient appliances to non-served complexes and invoicing PSE for those deliveries. The decision was made to work with one appliance supplier for all PSE residential programs who has experience installing & recycling them.

'4. There is need for more participant education on available rebates and other assistance. There was evidence from the stalled participant survey that more program information and assistance could have helped them move beyond the audit to project implementation. As noted above, 18% of the stalled participants said that they installed measures recommended by the program audit without seeking a rebate for these measures. When we asked them why they did not seek a rebate from PSE, their responses included not knowing about the rebates and believing they were ineligible for them. These responses indicate that the program could be doing more customer education in terms of drawing a stronger link between the audit recommendations and the programs rebate offerings.

5. Twenty-two percent of those stalled participants who recalled audit recommendations said additional information could have helped them implement some measures. The helpful information they mentioned included having someone come to give a bid for the work, getting back in touch with the implementers, a more detailed breakdown of what is available and the type of resources available to get it, and to receive more information on the measures. (p. 10)'

Program Response: If a property manager or owner does not have a contractor to install the energy efficiency measures, the program now offers referrals to members of PSE's Contractor Alliance Network. Also, a program representative re-contacts the customer within 4-6 weeks if they have not taken action in that timeframe to learn why they have not begun the process. This re-engages the manager to take action.

Our program implementer is hiring a portfolio manager who will work directly with property management firms to build and maintain long term relationships, including encouraging and assisting them in program participation and informing them about new program opportunities. We believe this will eliminate program confusion for the property owners and managers.

6. The large majority of the stalled participant respondents only had very limited authority for project approval. Seventy-four percent of the stalled participant respondents said that they needed additional authorization over a certain dollar limit. Of those who needed additional authorization, the mean dollar amount they had authorization up to was $1,046 and the median was $500. This indicates that while the respondents were people involved in the program, they did not have sole authority to decide what equipment to install and how much of it to install. The authority generally rested with the owner (33%) or the regional manager (29%). This means that persuading the onsite manager may not be enough to get an energy efficiency project to move forward (p. 10)'

Program Response: Response: We plan to implement a portfolio marketing approach. We will develop a presentation and tools we will use during the presentation, which will be directed at the company's regional level for larger property management firms. The goal is to meet with the decision makers, present to them and they will ask the site managers to arrange site audits. We will then present the findings to the portfolio managers and work with them to discuss budgets and implementation of measures.

'7. Many recent participants are not recalling the program rebates, which could negatively impact program attribution. Forty percent of the full participants said they did not receive a rebate or incentive. This is surprising because their participation was relatively recent and so one would not expect many to have forgotten about the measures. This low level of full participant recall should be a concern for the program since it will reduce levels of program attribution (e.g., increase free ridership). It is possible that some of these full participants were unaware of the rebate because their contractors took the rebates and gave them line-item discounts instead, which is allowable under the current program. However, it is surprising that the contractors would receive the rebates this frequently. And even in these cases, one would assume that the contractors would still mention the discount as being program-influenced (p. 10).'

Program Response: Contractors typically secure the rebates and charge the owner only the balance of the costs. This means that there is less out of pocket costs for the owner. The owner must assign the funds to the contractor prior to installation of measures. The property manager may not know that there are incentives or that the contractor received the incentives because the property manager may not have made the financial decisions. To address the attribution issue and promote customer awareness of PSE energy efficiency efforts, n 2014 we implemented a "Strive for Five" plaque that identifies the measures installed at the site and informs residents and the manager of the measures installed.

'8. Email is the preferred means for providing program information. The survey asked the full participants about their preferred method of contact if PSE were to provide them with more information about rebates and other program services. The large majority (71%) of respondents cited email as their most preferred method of contact. The second and third most-cited preferences were in the mail, separate from the bill (28%) and as a bill insert (15%). It is not clear how frequently the program currently uses email to communicate program information but these findings indicate that there are opportunities to do more of these types of communications (p. 10).'

Response: The program team typically contacts property managers by email. In 2016 we plan to implement an email newsletter for property managers that will provide routine program information,

including information on new measures, new incentives, critical dates, and articles highlighting selected complexes, property managers, and program partners.