Measure Adoption Rate and Attitudinal Survey for Residential Energy Assessments and Rating Projects

Final Report

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1 Introduction

1.1 Program Description

The New York State Clean Energy Fund (CEF) Single Family Residential Plan, Residential Initiative is comprised of market interventions with a goal of driving energy savings and electrification in single family housing. This initiative includes the Residential Energy Assessment Program and the Home Energy Ratings pilot program.

Through both the Residential Energy Assessment Program and the Home Energy Ratings pilot, consumers are provided with clear, relevant, and actionable information about the energy performance of their homes to help them make informed decisions about energy improvements. The Residential Energy Assessment Program provides free energy audits and the Home Energy Rating pilot was designed to test two rating systems: the U.S. Department of Energy's Home Energy Score[1] and the Pearl Certification.[2] The pilot was designed to engage with residential contractors and home inspectors to deliver these home energy ratings.

Both the Residential Energy Assessment Program and the Home Energy Ratings pilot focus on market rate participants but may also include low-to-moderate-income participants as well.

This evaluation of these programs has been conducted to meet the requirements of the Performance Management, Analyses & Evaluation Plan section of the Clean Energy Fund (CEF) Compiled Investment Plan.[3]

1.2 Summary of Evaluation Objectives and Methods

The primary objective of this evaluation was to estimate average savings per household by residential energy rating or audit type and measure, if possible, using a Measure Adoption Rate ("MAR") approach. The MAR approach quantifies the percentage of study-recommended savings that customers chose to adopt. The Impact Evaluation Team ("the team") validated energy savings and calculated realization rates in accordance with International Performance

[1] https://www.nyserda.ny.gov/Residents-and-Homeowners/At-Home/Home-Energy-Audits-and-Ratings/Home-Energy-Score

[2] https://www.nyserda.ny.gov/Residents-and-Homeowners/At-Home/Home-Energy-Audits-and-Ratings/Pearl-Home-Certification

[3] NYSERDA, https://www.nyserda.ny.gov/About/Funding/Clean-Energy-Fund

Measurement and Verification Protocol (IPMVP) standards (e.g., using Option C) for a subset of audits in the MAR assessment.

An additional objective of this evaluation was an attitudinal assessment of participants, including process-related research.

Table 1-1 summarizes the objectives of this study, as well as the research questions and data sources used to meet those objectives.

Table 1-1. Study objectives, research questions, and methods

Research Objective	Purpose (Evaluation Questions)	Data Sources & Analytic Methods
Assess participant measure adoption rate (MAR) of energy efficiency home improvements	Which home energy efficiency measures recommended in the audit/assessment have been adopted resulting from the audit/assessment, by energy rating/audit type, and why were these measures adopted?	NYSERDA project data; survey of participant end-users; MAR
Assess cost of investment in energy efficiency home improvements made by participants	Of the energy efficiency measures adopted resulting from program activities, what is the associated cost(s) of investments made by the participant?	NYSERDA project data; survey of participant end-users
Assess participants' investments toward achieving clean energy goals	What are the energy savings attributable to program activities and associated with investments in energy efficiency home improvements?	NYSERDA project data; survey of participant end-users
Validate energy savings estimates for a representative number of projects for each of the three programs, respectively	Of the energy audits or ratings with installed recommended energy measures, what is the energy savings realization rate?	Validation of energy savings utilizing utility consumption data for a subset of MAR respondents
Compare the accuracy of the tools used by the Residential Energy Assessments, Home Energy Score and Pearl Certification programs to estimate energy savings of a project prior to install	Which of these tools estimated energy savings with the most accuracy? Why did some tools estimate energy savings more accurately than others?	Pre/post consumption analysis to identify distinct adjustment factors by recommendation category; propensity analysis to identify recommendation categories associated with high positive or negative discrepancies
Assess improvements made to residential supply chain actors' offers for providing energy efficiency and clean energy services	Which improvements with respect to service offerings that have been adopted resulted from program activities? What improvements have been made to the supply chain actors' sales process?	NYSERDA project data; survey of home energy ratings contractors and home inspectors, and audit program contractors

Research Objective	Purpose (Evaluation Questions)	Data Sources & Analytic Methods
Assess improvements in contractors' sales resulting from reduced consumer acquisition costs, faster sales process	Has the Home Energy Score, Pearl Certification, or Residential Energy Assessments offer impacted the residential consumer awareness of energy efficiency, the uptake of energy upgrades, or the conversion rates for contractors?	NYSERDA project data; survey of home energy ratings contractors; survey of audit program contractors
Demographics and Decision Making; Inform CLCPA [a] and NYSERDA's response to COVID-19	Of these participants, what percentage is low- to moderate-income (LMI)? Of these participants, what percentage are based in disadvantaged communities? Of participating contractors, what percentage are working in disadvantaged communities? How has the COVID-19 pandemic impacted the adoption of energy efficiency home improvements? How has COVID-19 impacted the household profile (i.e., increase in household members, working or schooling remotely, etc.)	NYSERDA project data; contractor survey; survey of participant end-users
Non-energy benefits to customers	What non-energy benefits were experienced by customers who adopted measures, and to what extent?	Survey of participant end-users
Assess indirect benefits to the program	What energy benefits resulted from measure installations that were influenced by the audit but that were not directly recommended?	Survey of participant end users
Assess which delivery approach is most effective	Do the ratings programs have higher MAR, verified gross, or attributable gross compared to the audit program? Are there meaningful differences between the two ratings programs in terms of these metrics?	Cross-program comparison of results by location and other key characteristics, to the extent practical given population counts

[a] Source: https://legislation.nysenate.gov/pdf/bills/2019/S6599

2 Impact Evaluation Results

This section presents the results and findings from this impact evaluation.

2.1 Gross Energy Savings Results

This section explains measure adoption rate (MAR), the primary factor developed as part of this effort to determine gross savings.

2.1.1 Measure Adoption Rate and Program Energy Savings

Evaluators calculated MAR for each of the programs. For the Residential Energy Assessment Program and the Home Energy Score pilot, the MAR quantifies the percentage of savings recommended through the audit program that customers self-reported as installed. For the Pearl Certification pilot, the team used Pearl points[4] as the basis for MAR, in lieu of savings since the pilot did not quantify or track recommended savings. The evaluated time period for each program and the long-term MAR (after more than 1 year since the audit or rating), can be seen in Table 2-1.

Table 2-1. Measure adoption rate by program

Program	Evaluated Time Period	Measure Adoption Rate		
		Overall	Electricity	Fossil Fuel
Residential Energy Assessment Program	January 1, 2020 – December 31, 2021	38.8%	50.8%	37.7%
Home Energy Score Pilot	January 1, 2019 – December 31, 2021	39.8%	51.6%	39.4%
Pearl Certification Pilot	January 1, 2019 – December 31, 2021	37.9%	N/A	N/A

The long-term MAR and gross savings (direct program impact) by fuel type for the Residential Energy Assessment Program and the Home Energy Score Pilot are shown in Table 2-2. The Pearl Certification pilot is not included in the table since the pilot did not quantify or track recommended savings.

[4] "The Pearl scoring system assigns points to home features based on how much they contribute to the home's performance. The more points a feature earns, the more it contributes to comfort, indoor air quality, and energy efficiency" Per https://betterbuildingssolutioncenter.energy.gov

Table 2-2. Audit recommended and installed energy savings (adjusted gross impact)

Program	Fuel	Units	Number of Participants	Audit Recommended Annual Savings	Audit Recommended Annual Savings per Participant	Measure Adoption Rate	Installed Annual Savings	Installed Annual Savings per Participant
Residential Energy Assessment Program	Electricity	kWh	3,397	5,393,197	1,587	50.8%	2,737,946	806
	Natural Gas	MMBtu	2,837	123,205	43	36.5%	44,988	16
	Other[a]		560	26,549	47	42.9%	11,394	20
	Total[b]		**3,397**	**168,156**	**49**	**38.8%**	**65,174**	**19**
Home Energy Score Pilot	Electricity	kWh	174	87,173	501	51.6%	44,948	258
	Natural Gas	MMBtu	161	5,202	32	41.6%	2,165	13
	Other[a]		13	435	33	6.3%	27	2
	Total[b]		**174**	**5,934**	**34**	**39.8%**	**2,364**	**14**

a Includes fuel oil, wood, and propane

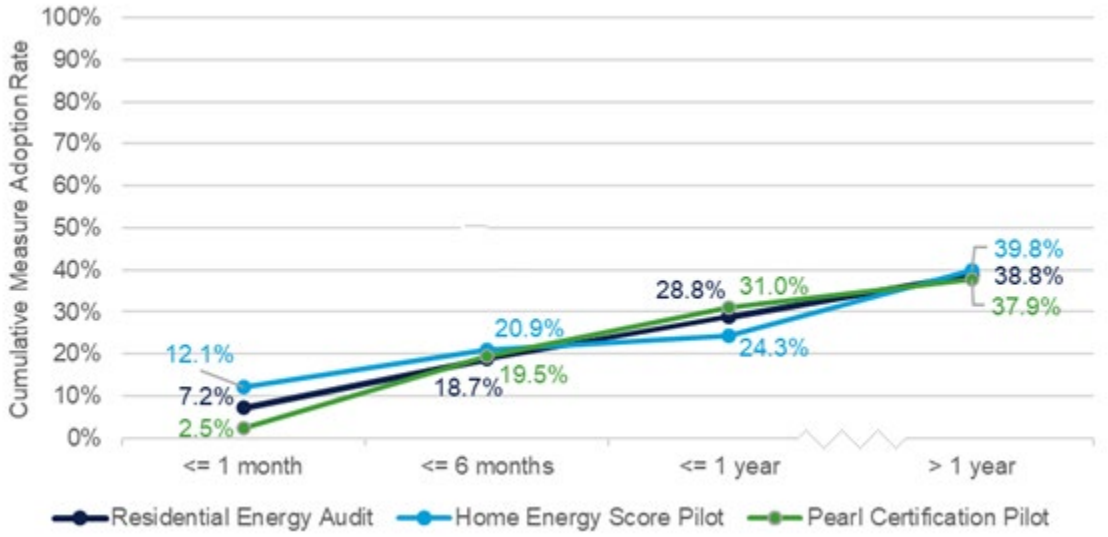
b Includes electricity savings converted to MMBtu

For the Residential Energy Assessment Program, the total program long-term MAR for the combination of all measures is 39%. The total installed energy savings for that population is 65,174 MMBtu, which amounts to an average savings value of 19 MMBtu per household. The calculated relative precision for this result is 8% at 90% confidence.

For the Home Energy Score pilot, the total program long-term MAR for the combination of all measures is 40%. The total installed energy savings for that population is 2,364 MMBtu, which amounts to an average savings value of 14 MMBtu per household. The calculated relative precision for this result is 38% at 90% confidence.

The team examined the MAR over time, as described in the methodology, using expansion weights associated with the study multiplied by the source-equivalent energy savings to represent the relative influence of each measure on the results. The MAR over time since the audit or rating can be seen in Figure 2-1.

Figure 2-1. Measure adoption rate over time (time since audit completion date)



The MARs at more than one year since the audit or rating is a best estimate of the long-term MAR in this evaluation. At the time of the survey, respondents had between 15 to 45 months since the audit or rating to install measures. The long-term MARs are fairly consistent with the long-term MAR found in previous studies, the most recent of which was the Audit Only Evaluation completed in 2020 where the total energy MAR was found to be 46%. However, the team was unable to determine whether the MAR for these programs has plateaued yet given the short amount of time that has elapsed for most of these projects.

2.1.2 MAR Breakdown by Measure and Program

In addition to looking at the total program MAR for each of the three programs, the team also estimated the MAR for each recommended measure or measure group. The team looked at the MAR for each measure group that was recommended in each program. The Residential Energy Assessment Program had the largest number of different recommended measures; however, there were commonly recommended measures across all three programs. The breakdown by measure group for each program is presented in Table 2-3 through Table 2-5.

Table 2-3. Measure adoption rate by measure, Residential Energy Assessment Program

Measure	Participants Surveyed	Recommended Measure Count	% of Measures Installed	Installed Measure Count	Recommended Savings[a] (MMBtu)	Measure Adoption Rate[b]	Installed Savings
Insulation	355	7,171	31.5%	2,256	71,173	36.5%	25,960
Air Sealing	313	3,036	55.9%	1,696	19,216	60.8%	11,678
Duct Sealing	86	1,488	30.8%	458	5,695	31.6%	1,799
Windows	51	506	16.6%	84	3,884	9.1%	354
Heating System	217	4,090	19.6%	802	26,788	30.1%	8,065
Central Cooling	8	1,368	37.4%	512	283	21.8%	62
Dehumidifier	6	646	33.2%	214	625	50.3%	314
Thermostat	194	1,991	51.9%	1,033	13,624	51.8%	7,052
Water Heater	185	1,957	33.5%	656	14,612	33.2%	4,858
Water Conservation	26	3,777	1.7%	65	2,138	3.7%	79
Lighting	122	2,245	47.2%	1,060	7,936	46.8%	3,717
Refrigerator	7	2,374	3.9%	92	1,025	5.5%	56
Clothes Washer	14	1,555	34.2%	533	1,114	43.0%	479
Dishwasher	2	1,005	0.0%	-	44	0.0%	-
Overall	**389**	**33,209**	**28.5%**	**9,460**	**168,156**	**38.8%**	**64,473**

a Savings shown are combined electric and fossil fuel savings

b The individual end use MARs as well as the total of 38.8% represent a weighted average based on savings

For the Residential Energy Assessment Program, air sealing, thermostats and lighting were the most adopted measures by savings (meaning they had the highest MAR values). Water conservation measures had the lowest adoption rate. Controls and lighting measures generally have the lowest upfront cost and are considered the most accessible to customers.

Table 2-4. Measure adoption rate by measure, Home Energy Score Pilot Program

Measure	Participants Surveyed	Recommended Measure Count	% of Measures Installed	Installed Measure Count	Recommended Savings[a] (MMbtu)	Measure Adoption Rate[b]	Installed Savings
Insulation	32	163	42.9%	70	2,711	35.4%	961
Air Sealing	38	161	65.1%	105	1,388	65.9%	914
Duct Sealing	9	43	33.6%	14	425	42.3%	179
Windows	2	6	11.3%	1	77	12.5%	10
Heating System	18	71	25.0%	18	902	26.2%	236
Central Cooling	4	16	33.0%	5	27	49.9%	13
Water Heater	21	91	20.7%	19	339	22.6%	76
Overall	**42**	**551**	**42.1%**	**232**	**5,869**	**39.8%**	**2,390**

a Savings shown are combined electric and fossil fuel savings

b The individual end use MARs as well as the total of 39.8% represent a weighted average based on savings

c Window AC is not included in this table since no there were no completed surveys for this measure.

For the Home Energy Score pilot, air sealing, central cooling, and insulation were the most adopted measures by savings (meaning they had the highest MAR values). However, it is worth noting that only four recommendations were included for central cooling upgrades within the survey responses recorded.

Table 2-5. Measure adoption rate by measure, Pearl Certification Pilot Program

Measure	Participants Surveyed	Recommended Measure Count	% of Measures Installed	Installed Measure Count	Recommended Pearl Points	Measure Adoption Rate[a]	Installed Pearl Points
Insulation	45	145	30.8%	45	1,797	38.4%	690
Air Sealing	45	52	54.4%	28	1,538	57.7%	887
Duct Sealing	22	32	22.0%	7	263	20.1%	53
Windows	17	20	8.7%	2	517	9.1%	47
Heating System	33	40	21.9%	9	2,878	28.8%	830
Central Cooling	27	30	23.6%	7	728	38.9%	283
Thermostat	18	19	48.5%	9	288	44.8%	129
Water Heater	29	32	46.0%	15	962	48.7%	468
Lighting	16	19	43.1%	8	191	41.7%	80
Refrigerator	1	1	0.0%	-	3	0.0%	-
Overall	**56**	**390**	**33.3%**	**130**	**9,165**	**37.9%**	**3,467**

a The individual end use MARs as well as the total of 37.9% represent a weighted average based on Pearl points[5]

For the Pearl Certification pilot, air sealing, water heaters, and thermostats were the most adopted measures (meaning they had the highest MAR values). Refrigerators and windows had the lowest adoption rates.

2.1.3 Electrification and Electrification-Ready MAR

For the Residential Energy Assessment Program, the team also looked at the MAR for electrification and electrification-ready measures. These measures are important to the program, as the program is interested in advancing the installation of these measures. The team will also continue to track these values over time with subsequent rounds of this evaluation. Table 2-6 presents the MAR by measure group and overall, for electrification and electrification-ready measures recommended in the Residential Energy Assessment Program. The overall MAR for electrification and electrification-ready measures is similar to the overall MAR for all Residential Energy Assessment Program measures.

[5] "The Pearl scoring system assigns points to home features based on how much they contribute to the home's performance. The more points a feature earns, the more it contributes to comfort, indoor air quality, and energy efficiency" Per https://betterbuildingssolutioncenter.energy.gov.

Table 2-6. Electrification/electrification-ready MAR, Residential Energy Assessment program

Measure	Participants Surveyed	Recommended Measure Count	% of Measures Installed	Installed Measure Count	Recommended Savings[a] (MMBtu)	Measure Adoption Rate[a]	Installed Savings
Air Sealing	313	3,036	55.9%	1,696	19,216	60.8%	11,678
Attic/Roof Insulation	330	2,807	46.6%	1,308	33,031	52.3%	17,276
Floor Insulation	117	924	8.1%	75	5,022	2.6%	129
Basement/ Crawlspace Insulation	200	1,538	31.7%	488	5,126	37.4%	1,916
Wall Insulation	202	1,902	20.9%	398	27,994	20.7%	5,804
Heating System - ASHP	57	2,260	15.1%	341	11,599	33.4%	3,869
Heating System - Secondary	0	1	N/A	N/A	(0)	N/A	N/A
Water Heater	0	12	N/A	N/A	(15)	N/A	N/A
Windows	51	506	16.6%	84	3,884	9.1%	354
Overall	**378**	**12,986**	**33.8%**	**4,389**	**105,856**	**39.6%**	**41,027**

a Savings shown are combined electric and fossil fuel savings

2.2 Consumption Data Analysis Results

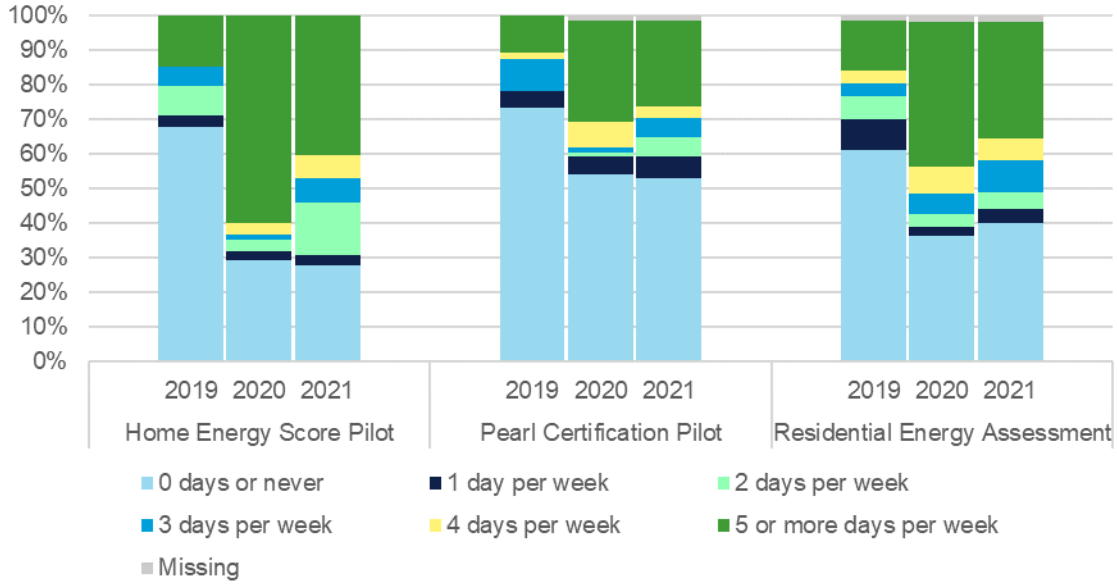
The consumption data analysis (billing analysis) provides estimates of participating customer household energy savings using consumption records from utility billing data. Results from this analysis provide an alternative empirical assessment of program activity that can be viewed in comparison to the MAR results. The billing analysis, however, requires more lag time than the survey-based MAR results and, as a result, at this early stage in the programs' existence, the billing analysis results are limited in a number of ways, therefore the evaluation team is not recommending application of the billing analysis results at this time.

First, the billing analysis results are based on the 2020 participants only. This restriction was necessary to allow not-yet-treated 2021 participants to serve as a comparison group in the analysis, as described further in Section 4. For purposes of this evaluation, evaluators assumed that the savings per participant are the same for the 2021 participants as was determined from the billing analysis of 2020 participants.

Importantly, during March 2020, states began to implement shutdowns and stay-at-home orders to slow the spread of COVID-19 resulting in significant changes in behavior and energy consumption. As part of the customer survey, participants were asked how many days per week

they worked from home on average in 2019, 2020, and 2021. As can be seen in Figure 2-2, the number of days worked from home per week significantly increased from 2019 to 2020, as expected. Further, while the number of days worked from home per week decreased from 2020 to 2021, it was still significantly more than 2019.

Figure 2-2. Number of days worked from home per week



As observed generally and through the survey, the occupancy of residential homes increased following March 2020 and, by extension, energy consumption also increased. The billing analysis controls for non-program related changes in consumption by using a matched comparison group. Since the matched comparison group is unaffected by the program but is affected by the same non-program related changes as the treatment group, exogenous consumption changes are controlled for in the billing analysis savings estimates through a difference-in-differences framework.

While the billing analysis savings estimates are unbiased estimators of savings, it is possible that the level of savings would change if household occupancy and energy consumption changes. Greater household occupancy and increased energy consumption provide the potential for a greater level of savings from energy efficiency measures than otherwise. A return to previous norms may provide a lower level of savings, but as shown in the figure above, that had not occurred yet as of 2021.

Another limitation of the billing analysis is that they reflect savings only for measures implemented by the end of the first year. In general, as indicated in Figure 2-1 above, measures

implemented within the first year are not all in place for the entire year, and additional measures are implemented after the first year. The analysis includes an adjustment factor to scale up the observed first-year savings to the long-term MAR. The adjustment factor used to scale up the observed first-year savings to the long-term MAR equals the long-term MAR divided by the 6-month MAR.

A final limitation of the billing analysis is the data available for the analysis. The relatively small number of analysis-eligible participants produces results with poor precision. This is particularly the case for electric results where expected savings are small and natural variation in the household data greater. For this round, as seen in Section 2.2.4 below, none of the electric results are distinguishable from zero. Because of their wide variability, some of these results, confusingly for the reader, are negative. All of the billing analysis results should be considered preliminary at this early stage of the program. As the timeframe of the program expands, more households will be available for both participant and comparison groups, supporting more reliable consumption data analysis results.

The data attrition described next shows the progression from the homes of interest to the study to those with adequate data for inclusion in the billing analysis. The results of that analysis are then described.

2.2.4 Billing Analysis Data Attrition

This section describes how program participants become part of the consumption data analysis. The evaluation team received billing data from all utilities with program participants. The team then applied a variety of data checks, modeled site-level consumption as a function of weather, where possible, and identified suitable matched comparison group members for each participant.

To be included in the billing analysis, a participating customer from the program year analyzed (2020) must have a) sufficient billing data to support pre- and post-implementation weather models and b) at least one later (2021) participant with multiple years of pre-installation data that can serve as a comparison household. As discussed in the methods section, data availability and data sufficiency challenges for many participants, and the limited timespan of available participants for the comparison group severely limit the number of participants included in the final billing analysis.

Included participants are from the 2020 program year. Participants in the National Grid service territory are the most numerous because the team received billing data for most of them, and they

have monthly actual reads. The team only received data for a subset of participants in the Con Edison area, and not all of the data were monthly actual reads. The team received billing data for a high proportion of participants in the RG&E service territory, but a relative low proportion had sufficient data due to less than every-two-month billing, meaning there were less than 50% of the months with actual meter reads. The other utilities had attrition rates that were not severe but had few participants to begin with. Central Hudson did not provide billing data.

An attrition rate of 50% is not unusual for billing analysis. Given the challenges with data sufficiency and availability of matches, the percentage of 2020 participants ultimately used in the billing analysis are substantially lower than 50% for some utility/fuel combinations.

Table 2-7 and Table 2-8 provide the attrition analysis for the participants from all three programs that were ultimately included in the electricity and natural gas billing analyses. The first row represents the number of participants for whom the team received tracking data. The second row shows the number of participants in the tracking data for whom billing data was received. The final line reflects the number of participants who had sufficient data themselves and had a matched comparison household.

Table 2-7. Attrition analysis of 2020 participant data included in the electricity billing analysis

Status of Counts	Electric				
	Consolidated Edison	National Grid	RG&E	Orange & Rockland	Central Hudson
2020 participants in roster	209	291	641	97	92
2020 participants in roster, with billing data	91	280	553	67	0
Number of 2020 participants used in final analysis; sufficient data and comparison group	32	218	14	41	0
Percent of 2020 participants in roster used in final analysis	15.3%	74.9%	2.2%	42.3%	0.0%

Table 2-8. Attrition analysis of 2020 participant data included in the natural gas billing analysis

Status of Counts	Natural Gas						
	Consolidated Edison	National Grid	RG&E	Orange & Rockland	National Fuel	NYSEG	Central Hudson
2020 participants in roster	124	180	665	74	60	111	21
2020 participants in roster, with billing data	42	158	570	47	62	100	0
Number of 2020 participants used in final analysis; sufficient data and comparison group	15	112	84	35	40	21	0
Percent of 2020 participants in roster used in final analysis	12.1%	62.2%	12.6%	47.3%	66.7%	18.9%	0.0%

2.2.5 Billing Analysis Savings Results

The results provided in Table 2-9 represent annual average, per-participant, first-year savings for 2020 Residential Energy Assessment Program participants. The results reflect the difference-in-difference savings estimates, as described in Section 4, for all participants that were included in the data analysis, as indicated in Tables 2-7 and 2-8 above. The savings estimates are for typical weather conditions and have been adjusted to reflect annual savings after long-term measure adoption.

Instances in Table 2-9 where savings are negative could indicate a consumption increase but more likely reflect underlying variability and the relatively low counts that made it into the billing analysis. The 90% confidence interval +/- indicates the statistical uncertainty.[6] If this quantity is smaller than the absolute value of the savings estimate, the savings estimate is statistically different from zero. This is never the case for electric results but is the case for most of the natural gas results, including the all-utilities result. The all-utilities natural gas estimate confidence interval +/- is just 35% of the natural gas estimate, meaning 90/35 precision which is a reasonable level of precision for a billing analysis.

The utility-level electric results are quite variable while also not being statistically significant. In addition, a relatively high portion of Residential Energy Assessment Program participants are RG&E customers, so the negative savings associated with RG&E individually drives the weighted program-level results. Relative to natural gas, fewer electric savings were recommended and adopted. All other things being equal, smaller savings will be more difficult to detect—that is, less likely to appear as statistically significant.

A further limitation of the billing analysis results is that, according to the survey, some customers that previously used natural gas as their primary heating fuel adopted a heat pump. This type of fuel substitution has the potential to obscure any electric savings that are occurring. While this type of fuel substitution puts downward pressure on the electric savings estimate and upward pressure on the natural gas savings estimates, the electric and natural gas billing analysis results reflect the total change in pre and post-consumption, and collectively represent energy savings. In

[6] The 90% confidence interval +/- is the amount that is subtracted from and added to the estimate to determine the lower and upper bounds of the 90% confidence interval. If the 90% confidence interval +/- is smaller than the absolute value of the savings estimate, the confidence interval does not include 0, and the savings estimate is statistically different from zero at 90% confidence, or a 10% significance level. Strictly speaking, the National Fuel negative savings results are also statistically different from zero, but this is an anomaly among the gas utility results.

the Residential Energy Assessment Program, 95% of participants have a fossil fuel primary heating fuel. Two-thirds of participants with a fossil fuel primary heating fuel were recommended a heat pump. According to the survey, about 13.5% of these participants installed the recommended heat pump. While a smaller portion of sites included in the billing analysis were recommended heat pumps, in the context of the billing analysis, if reasonable savings values are assumed for these heat pumps, heat pump fuel substitutions represent -170 kWh of electricity dissavings and more than 2 MMBtu of natural gas savings. Future analysis of this program will address this issue as it affects both fuels.

Table 2-9. Impact results by fuel and utility, Residential Energy Assessments Program

Utility	Fuel	Number of Households in Analysis	Savings Unit	Per-participant Savings	90% confidence interval +/-	Statistically significantly from 0 at 90% confidence
Consolidated Edison	E	29	kWh	175	2,588	No
National Grid		218		205	344	No
Orange and Rockland		41		-355	618	No
Rochester Gas & Electric		11		-550	1,328	No
Overall, First Year		**299**		**-234**	**832**	**No**
Overall, Long Term[a]		**299**		**-510**	**1,812**	**No**
Consolidated Edison	G	15	MMBtu	8.5	10.9	No
National Fuel		39		-12.9	8.1	Yes
National Grid		112		3.5	3.3	Yes
NYSEG		21		9.1	6.1	Yes
Orange and Rockland		35		0.1	6.6	No
Rochester Gas & Electric		82		8.8	3.6	Yes
Overall, First Year		**304**		**6.4**	**2.4**	**Yes**
Overall, Long Term[a]		**304**		**11.9**	**4.5**	**Yes**

a The long term savings estimate equal the first year savings estimate multiplied by the ratio of the long term MAR to the 6 month MAR. The ratios for electricity and natural gas were 2.18 and 1.87, respectively.

Future evaluations will allow for a greater number of participants in this kind of analysis. There will be more participants, to start, but more importantly the longer timeframe will provide a larger group of potential match customers allowing for more participants to be included with better matches. It may also be possible to implement improved filtering of customers with problematic consumption data. The team ran models under a variety of filters and those results indicate that the electric results are highly sensitive to different filter criteria.

2.3 Indirect Benefits

The evaluation team reviewed and considered how to evaluate indirect energy benefits for these programs as a part of this evaluation. However, upon consideration, the team determined that indirect benefits could not be effectively evaluated through this study for a number of reasons, including anticipated challenges contacting non-participants to assess follow-on activity and challenges to evaluating indirect energy savings from participant adoption that are not captured in the evaluation team's assessment of energy savings at the participant site. Therefore there are no indirect benefits reported through this study.

2.4 Reported Savings and Billing Analysis Savings Realization Rates

This section presents a comparison of the program reported savings and the results of the evaluation billing analysis. Due to the issues described above with the consumption data analysis at this stage, evaluators do not recommend the program report on these values, they are being presented for information purposes only.

A summary of the program reported savings is shown in Table 2-11. The values shown are the total savings and MAR values reported by the program for the Residential Energy Assessment Program and the two pilots. A breakdown of the totals by contractor and inspector providers was determined by the evaluation team from the spreadsheet used by the program to produce those reports and is shown in Appendix B of this report. The evaluation team calculated the installed and recommended savings per participant from the reported totals and MAR.

Table 2-10. Program reported savings

Program	Fuel*	Reported				
		Total Savings	Total Participants	Measure Adoption Rate[a]	Recommended Savings per Participant	Installed Savings per Participant
		A (per Reporting data)	B (per Reporting data)	C (per Reporting data)	D (E/C)	E (A/B)
Residential Energy Assessments Program (2020-2021)	Electricity	2,025,715	3,209	46%	1,372	631
	Fossil Fuel	49,383	3,209	46%	33	15
Home Energy Score Pilot (2019-2021)	Electricity	36,464	163	42%	529	224
	Fossil Fuel	2,105	163	40%	32	13
Pearl Certification Pilot (2019-2021)	Electricity	86,741	455	33%	577	191
	Fossil Fuel	4,559	455	34%	30	10

* Savings for electricity are shown in kWh. Savings for fossil fuel are shown in MMBtu.

[a] Measure Adoption Rates based on a prior evaluation: https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016-2018-GJGNY-Audit-Only-MAR-Impact-Evaluation-Report.pdf

The savings shown above were calculated and reported by the program by applying the MAR values provided to the evaluation team in the reporting information to the recommended savings from the audits. In the case of the Pearl pilot, the program used average per home savings from Home Energy Score to estimate the reported energy savings because no recommended savings were calculated as part of the Pearl ratings.

A summary of the program evaluated savings from the billing analysis is given in Table 2-12.

Table 2-11. Evaluated savings

Program	Fuel*	Component	Evaluated				
			Total Savings	Total Participants	Long Term Measure Adoption Rate	Implied Recommended Savings per Participant	Long Term Installed Savings per Participant
			A	B	C	D	E
			(B x E)	(per program roster)	(per customer surveys, Table 2-1)	(E/C)	(per billing analysis, Table 2-9)
Residential Energy Assessments Program	Electricity	Overall	-1,732,777	3,397	0.51	-1,005	-510
(2020-2021)		Standard Error (Overall)	3,741,747		0.06		1,101
	Fossil Fuel	Overall	40,418	3,397	0.38	32	12
		Standard Error (Overall)	9,319		0.02		3
Home Energy Score Pilot	Electricity	Overall	-88,756	174	0.47	-1,078	-510
(2019-2021)		Standard Error (Overall)	191,659		0.12		1,101
	Fossil Fuel	Overall	2,070	174	0.39	30	12
		Standard Error (Overall)	478		0.09		3
Pearl Certification Pilot**	Electricity	Overall	-264,227	518	0.38	-1,346	-510
(2019-2021)		Standard Error (Overall)	570,570		0.05		1,101
	Fossil Fuel	Overall	6,163	518	0.38	31	12
		Standard Error (Overall)	1,421		0.05		3

*Savings for electricity are shown in kWh. Savings for fossil fuel are shown in MMBtu.

**For the Pearl Certification pilot, the team used Pearl points as the basis for MAR, in lieu of savings since the pilot did not quantify or track recommended savings. Therefore, the overall MAR was used for both electricity and fossil fuel since the MAR cannot be broken out by fuel.

The evaluated long term installed savings per participant is the annual average, per-participant, first-year savings determined via the billing analysis for 2020 Residential Energy Assessment Program participants adjusted to reflect annual savings after long-term measure adoption, as described in Section 2.2.4 and Section 4. These values were also applied to the Home Energy Score and Pearl Certification pilots since there was not sufficient data to support consumption analysis for these programs. The evaluated total savings is the average installed savings multiplied by the number of participants in 2020 and 2021. For the Home Energy Score and Pearl Certification pilots, audits were completed by either inspectors or contractors. Since MARs may vary depending on whether an inspector or contractor conducted the audit, evaluators post-stratified by the audit provider type. The electricity MAR for inspectors for the Home Energy Score pilot is imputed since no survey responses were provided for electricity savings measure recommended by an inspector. The electricity MAR for inspectors for the Home Energy Score pilot is imputed as the fossil fuel MAR for Home Energy Score inspectors multiplied by the ratio of the electricity and fossil fuel MARs for Home Energy Score contractors. In the case of the Pearl pilot, the average per home savings from Home Energy Score by provider type was used because no recommended savings were calculated as part of the Pearl Audits. The implied recommended savings per participant, long term installed savings per participant, and total savings for the Home Energy Score and Pearl Certification pilots cannot be estimated by provider type because the billing analysis results cannot be broken out by provider type. Results broken out by provider type are shown in an appendix.

Ratios for each of the program reporting quantities in Table 2-10 are shown in Table 2-12, along with standard errors where appropriate. Each column of Table 2-12 is the ratio of the indicated column of Table 2-11 to the corresponding column of Table 2-10.

A summary of the program reporting and evaluation results and resulting ratios by program and fuel is given in Table 2-13. Of key interest here is the Total Savings realization rate, which is the ratio of the evaluated to reported total savings. For fossil fuels, these realization rates are in the range of 80% to 135% across the 3 programs. For the Residential Energy Assessments and Home Energy Score programs the realization rates are not significantly different from 1. For the Pearl program, the realization rate is significantly greater than 1, indicating some understatement by the

reported numbers. For electricity, all 3 programs show negative realization rates, but these are not considered reliable or meaningful as discussed previously.

The Total Savings realization rate reflects the combination of differences between evaluation findings and reporting assumptions with respect to the total participant count, the MAR, the recommended savings per home, and the total installed savings per home, each shown separately in the table. Specifically, the Total Savings realization rate is the product of the realization rates for total participants, MAR, and Recommended savings per participant, which is also the product of realization rates for total participants and installed savings per participant.

Thus, the Residential Energy Assessment fossil fuel realization rate of less than 1 appears to be driven primarily by lower than assumed MAR. The Home Energy Score fossil fuel realization rate is near 1, as are its components. The Pearl fossil fuel realization rate of greater than 1 appears to be driven by each of the components, which all have a realization rate greater than 1.

Table 2-12. Realization rates - detailed

Program	Fuel	Component	Ratio of Evaluated Values to Program Utilized Values				
			Total Savings (per billing analysis)	Total Participants	Measure Adoption Rate	Recommended Savings per Participant	Installed Savings per Participant
Residential Energy Assessments Program (2020-2021)	Electricity (savings columns are in kWh)	Overall	-0.86	1.06	1.1	-0.73	-0.81
		Standard Error (Overall)	1.85		0.13		1.74
	Fossil Fuel (savings columns are in MMBtu)	Overall	0.82	1.06	0.82	0.94	0.77
		Standard Error (Overall)	0.19		0.04		0.18
Home Energy Score Pilot (2019-2021)	Electricity (savings columns are in kWh)	Overall	-2.43	1.07	1.12	-2.04	-2.28
		Standard Error (Overall)	5.26		0.28		4.92
	Fossil Fuel (savings columns are in MMBtu)	Overall	0.98	1.07	0.98	0.94	0.92
		Standard Error (Overall)	0.23		0.22		0.21
Pearl Certification Pilot (2019-2021)	Electricity (savings columns are in kWh)	Overall	-3.05	1.14	1.15	-2.33	-2.68
		Standard Error (Overall)	6.58		0.16		5.78
	Fossil Fuel (savings columns are in MMBtu)	Overall	1.35	1.14	1.12	1.06	1.19
		Standard Error (Overall)	0.31		0.16		0.27

Table 2-13. Realization rates summary

Program	Fuel	Result	Total Savings	Total Participants	Measure Adoption Rate	Recommended Savings per Participant	Installed Savings per Participant
Residential Energy Assessments Program (2020-2021)	Electricity (savings columns are in kWh)	Program Reporting	2,025,715	3,209	0.46	1,372	631
		Evaluation Results	(1,732,777)	3,397	0.51	(1,005)	(510)
		Standard Error (Evaluation Results)	3,741,747		0.06		1,101
		Realization Rates	(0.86)	1.06	1.10	(0.73)	(0.81)
		Standard Error (Realization Rates)	1.85		0.13		1.74
	Fossil Fuel (savings columns are in MMBtu)	Program Reporting	49,383	3,209	0.46	33	15
		Evaluation Results	40,418	3,397	0.38	32	12
		Standard Error (Evaluation Results)	9,319		0.02		3
		Realization Rates	0.82	1.06	0.82	0.94	0.77
		Standard Error (Realization Rates)	0.19		0.04		0.18
Home Energy Score Pilot (2019-2021)	Electricity (savings columns are in kWh)	Program Reporting	36,464	163	0.42	529	224
		Evaluation Results	(88,756)	174	0.47	(1,078)	(510)
		Standard Error (Evaluation Results)	191,659		0.12		1,101
		Realization Rates	(2.43)	1.07	1.12	(2.04)	(2.28)
		Standard Error (Realization Rates)	5.26		0.28		4.92
	Fossil Fuel (savings columns are in MMBtu)	Program Reporting	2,105	163	0.40	32	13
		Evaluation Results	2,070	174	0.39	30	12
		Standard Error (Evaluation Results)	478		0.09		3
		Realization Rates	0.98	1.07	0.98	0.94	0.92
		Standard Error (Realization Rates)	0.23		0.22		0.21
Pearl Certification Pilot (2019-2021)	Electricity (savings columns are in kWh)	Program Reporting	86,741	455	0.33	577	191
		Evaluation Results	(264,227)	518	0.38	(1,346)	(510)
		Standard Error (Evaluation Results)	570,570		0.05		1,101
		Realization Rates	(3.05)	1.14	1.15	(2.33)	(2.68)
		Standard Error (Realization Rates)	6.58		0.16		5.78
	Fossil Fuel (savings columns are in MMBtu)	Program Reporting	4,559	455	0.34	30	10
		Evaluation Results	6,163	518	0.38	31	12
		Standard Error (Evaluation Results)	1,421		0.05		3
		Realization Rates	1.35	1.14	1.12	1.06	1.19
		Standard Error (Realization Rates)	0.31		0.16		0.27

2.5 Customer Satisfaction, Investment, Non-Energy Benefits, and Demographics Results

In addition to studying the various program and individual measure MAR values and energy savings, this evaluation included assessments of customer satisfaction, the investments customers have made in order to implement the energy efficiency upgrades in their homes, and information on the demographics of the population including income level and how many participants are located within disadvantaged communities.

2.5.6 Customer Satisfaction

The team gathered customer satisfaction information from over 500 participants across the three programs. Overall, customers reported being satisfied with the programs.

The questions used a range of 1 to 5, where 1 is very dissatisfied and 5 is very satisfied. The closer the response number was to 5, the more positive the response. The distribution of responses for each of the customer satisfaction questions can be seen in Figure 2-2.

Figure 2-3. Customer satisfaction summary

The overall responses to the customer satisfaction questions were positive. No less than 60% of participants were very or somewhat satisfied across categories and programs. More than 70% of participants were very or somewhat satisfied overall across programs. On average, the ease of scheduling and professionalism categories receiving the highest scores across all three programs.

The question with the lowest average response was with respect to quality and value of recommendations. While still above 3, it is less than the other values and is the only category where less than 70% of respondents were very or somewhat satisfied across programs.

The satisfaction numbers were similar across the three programs as well. Home Energy Score had the lowest overall satisfaction number at 4.0, while the Residential Audit Program was at 4.1 and the Pearl Certification pilot was at 4.3. These values do not represent a significant difference in the customer experience with any of the programs in particular.

2.5.7 Customer Investment

The team also investigated the total investment customers were making in energy efficiency and clean upgrades to their homes as a result of the programs. Through customer surveys, the team collected information on the total investments made. Total customer investment represents the total cost (labor and equipment) of home improvements or efficiency upgrade(s) completed after the audit, as self-reported by customers in the survey. Table 2-15 shows a summary of these investments by program.

Table 2-14. Investments by program

Program	n	Average number of Installed Measures	Average Total Customer Investment
Home Energy Score Pilot	31	1.7	$11,146
Pearl Certification Pilot	52	2.1	$12,843
Residential Energy Assessment Program	320	2.4	$14,442

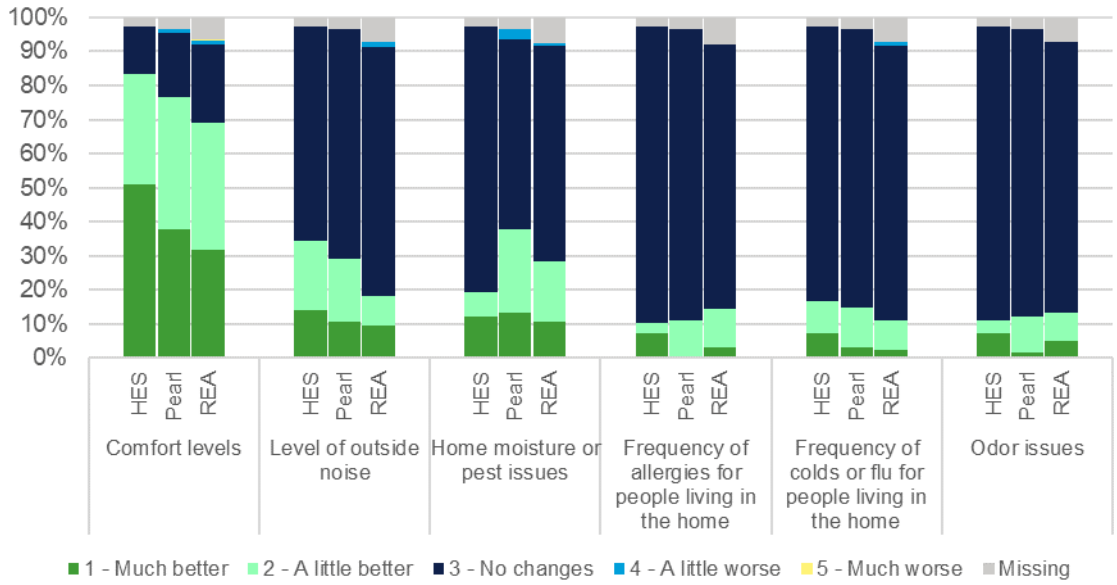
The Residential Energy Assessments Program had the highest average cost of investment, at over $14,000, and the Home Energy Score pilot had the lowest, at just under $10,000. In all three programs, customers have made significant investments, installing an average of around 2 measures per home and spending an average of over $10,000 on projects for energy efficiency resulting from these home audits.

2.5.8 Non-Energy Benefits

The customer survey also asked questions about non-energy benefits related to the home upgrades. Evaluators reviewed and analyzed these responses across all three programs. The non-energy benefits that the team asked about included comfort levels in the home, outside noise level, moisture or pest issues, frequency of allergies for people living in the home, frequency of colds or flu for people living in the home, and odor issues. The distribution of responses for each of the questions can be seen in Figure 2-5. The questions used a range of 1 to 5, where 1 is much

better and 5 is much worse than before the installation. The closer the response number was to 1, the more positive the response.

Figure 2-4. Non-energy benefit summary



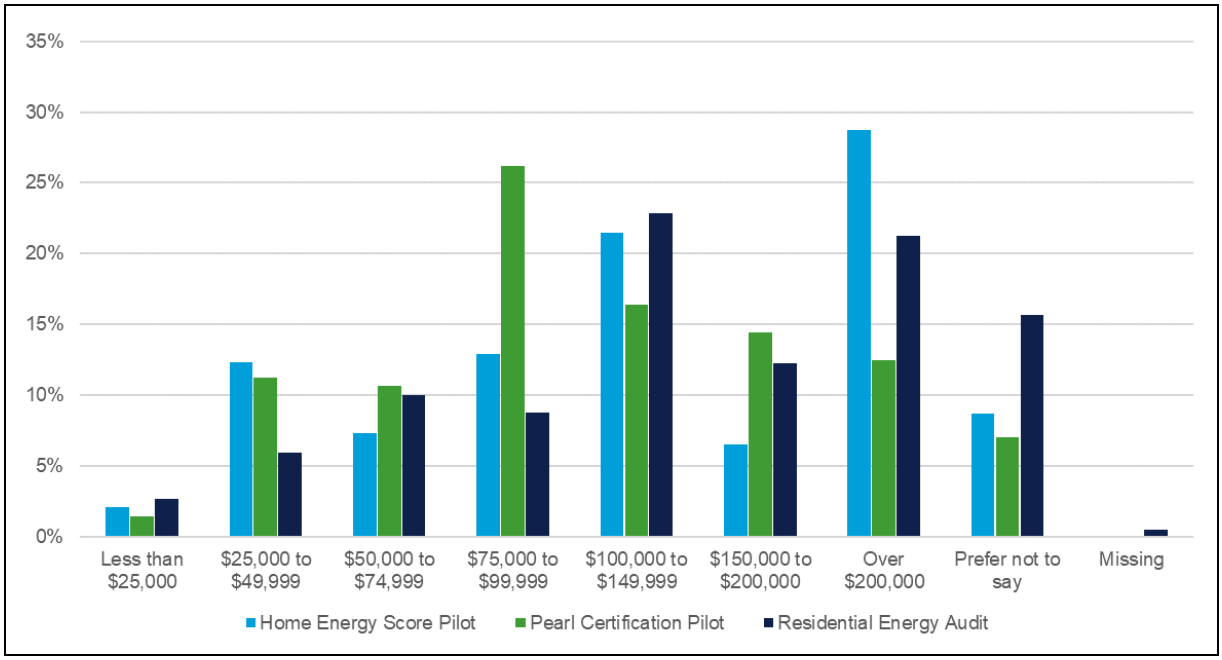
In all cases, with the exception of comfort levels, the responses averaged below, but somewhat near, a score of 3, indicating minimal impact from non-energy benefits reported by these customers. At least 69% of participants indicated that comfort levels were better than before across programs. However, in all other cases, the majority of participants indicated no change. Generally, no participants indicated that non-energy benefits were worse and in the few instances when they did, it was less than 5% of participants. The team also asked about the number of sick days from work, and the responses were largely that there was no difference from before measure installation, with 68% reporting no change in both the Residential Energy Assessment Program and the Home Energy Score pilot and 76% reporting no change within the Pearl Certification pilot.

2.5.9 Customer Demographics

Figure 2-6 shows a summary of the reported household income numbers from each of the programs. NYSERDA defines LMI households as those with incomes at or below the higher of 80% of area median income (AMI) and 80% of state median income (SMI). NYSERDA defines low-income households as having incomes at or below 60% of the SMI, or households that are income eligible for LIHEAP or WAP. In the results below, evaluators could not determine

whether or not each home was considered LMI due to the fact that the number of occupants was unknown.

Figure 2-5. Participant household income summary



2.6 Contractor Survey Results

This evaluation also included a survey of contractors approved to implement these three programs. The team assessed contractor satisfaction, program influences on contractor processes, and impacts of the COVID-19 pandemic.

2.6.1 Contractor Satisfaction

The team fielded 17 surveys with contractors who implement some or all of the three programs. Several contractors offer multiple programs; Table 2-16 shows the distribution of contractors by program.

Table 2-15. Distribution of surveyed contractors across programs

Program	Number of survey participant contractors by program
Home Energy Score Pilot	1
Pearl Certification Pilot	4
Residential Energy Assessments	16
Total respondents	**17**

Overall, contractor satisfaction was mixed. The average response for overall satisfaction, on a scale of 0-10 (with 0 being "very dissatisfied," 5 being neither satisfied or dissatisfied, and 10 being "very satisfied"), was 6.4. Table 2-17 shows the contractor satisfaction results for the Residential Energy Assessment Program, and Table 2-18 shows the results for the two pilot programs. Home Energy Score program results are not presented here since only one survey was completed for this program.

Table 2-16. Average contractor satisfaction for Residential Energy Assessment Program

Satisfaction category	N	Average response
Overall	16	6.5
NYSERDA staff audit review and feedback	15	6.9
NYSERDA contractor training for the audit program	13	6.5
NYSERDA payment processes	15	7.9

Table 2-17. Average contractor satisfaction for Pearl Certification and Home Energy Score Pilots

Satisfaction category	Pearl Certification Pilot (n=4)
Overall	5.75
Homeowner educational and marketing materials	6.25
NYSERDA contractor training and technical support	8.5
NYSERDA reimbursement and incentive payment processes	8.33

*Home Energy Score program results not presented here since only one survey was completed

2.6.2 Program Influences on Contractor Processes

The surveyed contractors were asked if and how participation in the NYSERDA programs impacted their sales processes. Of the 17 respondents, 7 (41%) indicated that they changed their sales processes due to the program, such as using NYSERDA materials to sell audits and sending out auditors directly to collect information from the customers. The majority of respondents

indicated that changes resulted in benefits such as faster sales cycles, lower costs of acquiring sales, and higher customer adoption of suggested upgrades. However, some contractors reported challenges working with NYSERDA systems, citing other programs such as NYSERDA's Comfort Home program offering easier processes and better incentives than the residential audit and rating programs. Multiple contractors reported that the NYSERDA Residential Audit web portal was often offline and when online was difficult to use, impacting processes and contractors' ability to close and convert projects. However, it should be noted that the timing of the survey coincided with a new software system rollout, which could have impacted these responses.

In addition to changes to processes, contractors reported overall that the programs increased customer awareness of energy efficiency opportunities in their homes. Specific contractor insights include:

- "Instead of just sending out salespeople for quotes, we send out auditor to create digital model and then send out sales person"
- "NYSERDA helped increase the value we can offer customers"
- NYSERDA program helped contractors get in the door to pitch programs
- Contractors often serve as the primary source of educating homeowners on the energy performance and efficiency opportunities within their home, as there is not a lot of information available online via NYSERDA regarding the programs and specific opportunities

2.6.3 Impacts of the COVID-19 Pandemic

Through the survey, the evaluators asked contractors about the impacts of the COVID-19 pandemic on their activities. Contractors across all programs identified increased homeowner demand for improvements to their house as well as increased adoption of recommended energy efficiency measures, likely due to the prevalence of working from home during the pandemic. Contractors identified that demand was highest from 2020 to 2022, but that demand was returning closer to pre-pandemic levels in 2023 as more employers are encouraging in-office work.

Despite the increase in demand, contractors face a variety of challenges from supply chain delays, staffing, and increased customer reluctance to site visits. Table 2-19 shows the distribution of challenges reported by contractors.

Table 2-18. Contractor reported challenges due to COVID-19 pandemic

COVID-19 contractor challenges (n=16)	Count of respondents
Delays in obtaining equipment	9
Difficulty in hiring/keeping labor to perform this work	6
Safety issues regarding COVID-19 transmission when on site	9
Customers reluctant to have us onsite	8
Increased cost of materials	2
Scheduling	1

2.7 Disadvantaged Communities

NYSERDA's Residential Energy Audit, Home Energy Score and Pearl Certifications were designed prior to implementation of New York State's Climate Leadership & Community Protection Act (CLCPA) in 2019, and therefore were designed prior to the state's efforts to identify Disadvantaged Communities (DACs) and target funding to them. However, many projects in these programs are located within DACs, as defined in New York State's final criteria for Disadvantaged Communities, as finalized by New York's Climate Justice Working Group in March 2023.

This section compares evaluation results for participants in disadvantaged communities (DACs) with results for participants not in DACs. Results are not shown where the team was unable to determine whether a participant is in a DAC (e.g., missing participant address).

2.7.4 Program Energy Savings

Table 2-20 summarizes the number of participants and annual savings recommended as part of the audit or rating by program, fuel, and DAC status. Savings are not shown for the Pearl Certification pilot since the pilot did not quantify or track recommended savings.

Less than 20% of participants in the Residential Energy Assessment Program and Home Energy Score Pilot Program are in DACs, while more than 25% of participants in the Pearl Certification Pilot Program are in DACs.

In the Residential Energy Assessment Program, total audit recommended annual savings per participant were 8% greater for DAC participants than non-DAC participants on average. While DAC participants in the Residential Energy Assessment Program tended to have greater natural gas audit recommended savings per participant than non-DAC participants, the DAC participants

tended to have lower electricity and other (i.e., fuel oil, wood, propane) audit recommended annual savings per participant than non-DAC participants.

In the Home Energy Score Pilot Program, DAC participants had less total audit recommended savings on average than non-DAC participants. While DAC participants in the Home Energy Score Pilot Program tended to have less natural gas and other audit recommended savings relative to non-DAC participants, the DAC participants tended to have greater electricity audit recommended savings than non-DAC participants.

Table 2-19. Audit recommended energy savings by DAC status

Program	DAC Status	Fuel	Units	Number of Participants	Audit Recommended Annual Savings	Audit Recommended Annual Savings per Participant
Residential Energy Assessment Program	DAC	Electricity	kWh	555	859,000	1,548
	Non-DAC			2,787	4,462,724	1,601
	DAC	Natural Gas	MMBtu	463	22,361	48
	Non-DAC			2,341	99,395	42
	DAC	Other[a]		92	4,031	44
	Non-DAC			446	21,541	48
	DAC	Total[b]		555	29,323	53
	Non-DAC			2,787	136,163	49
Home Energy Score Pilot	DAC	Electricity	kWh	23	11,958	520
	Non-DAC			113	57,286	507
	DAC	Natural Gas	MMBtu	22	664	30
	Non-DAC			105	3,692	35
	DAC	Other[a]		1	15	15
	Non-DAC			8	261	33
	DAC	Total[b]		23	719	31
	Non-DAC			113	4,148	37
Pearl Certification Pilot	DAC	Electricity	kWh	134	-	-
	Non-DAC			379	-	-
	DAC	Natural Gas	MMBtu	131	-	-
	Non-DAC			359	-	-
	DAC	Other[a]		3	-	-
	Non-DAC			20	-	-
	DAC	Total[b]		134	-	-
	Non-DAC			379	-	-

a Includes fuel oil, wood, and propane

b Includes electricity savings converted to MMBtu

2.7.5 Measure Adoption Rate

Table 2-21 shows the evaluated time period for each program, the long-term MAR (after more than 1 year since the audit or rating) by DAC status, and the number of survey respondents analyzed in estimating MAR. For the Residential Energy Assessments Program, the MARs are similar between DAC and non-DAC. For the Home Energy Score and Pearl Certification Pilots, the MARs for DAC are higher than for non-DAC. However, the differences are not statistically significant given the small DAC sample size for these latter two programs.

Table 2-20. Measure adoption rate by DAC status

Program	Evaluated Time Period	Disadvantaged Communities		Non Disadvantaged Communities	
		n	MAR	n	MAR
Residential Energy Assessment Program	January 1, 2020 – December 31, 2021	75	35.4%	304	39.4%
Home Energy Score Pilot	January 1, 2019 – December 31, 2021	5	61.5%	27	39.4%
Pearl Certification Pilot	January 1, 2019 – December 31, 2021	5	49.4%	51	36.9%

2.7.6 Customer Satisfaction

A total of 5, 5, and 74 customers in a DAC responded to the customer satisfaction questions in the survey for the Home Energy Score Pilot, Pearl Certification Pilot, and Residential Energy Assessments program, respectively. A total of 27, 51, and 301 customers in a non-DAC responded to the customer satisfaction questions in the survey for the Home Energy Score Pilot, Pearl Certification Pilot, and Residential Energy Assessments program, respectively.

Figure 2-7 compares customer satisfaction with different aspects of the audit/rating by DAC status. While there are too few respondents in a DAC for the Home Energy Score and Pearl Certification pilots to draw any meaningful conclusions as to how customer satisfaction varies by DAC status, it is worth pointing out that all Home Energy Score and Pearl Certification customers in a DAC were very or somewhat satisfied with the ease of scheduling, compared to less than 80% of customers in a non-DAC. All Home Energy Score customers in a DAC were also very or somewhat satisfied overall.

For the Residential Energy Assessment program, where the sample size was larger, about 80% of customer satisfaction was similar across categories, irrespective of DAC status.

Figure 2-6. Customer satisfaction summary by DAC status

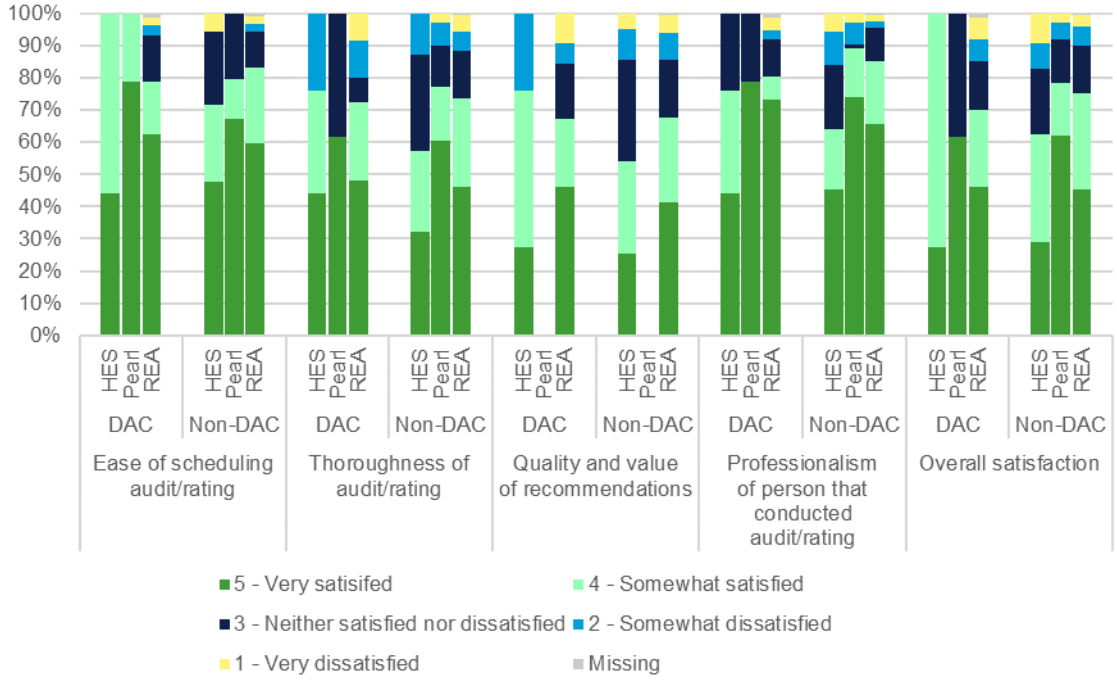
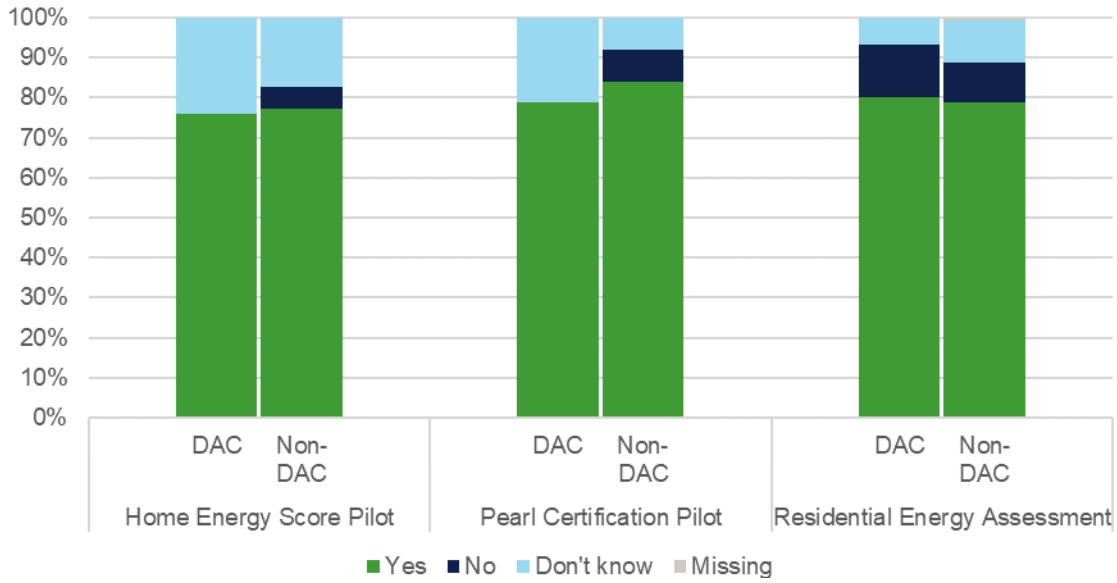


Figure 2-8 compares whether the customer would recommend the audit/rating to a friend, family member, or neighbor by DAC status. 75 to 85% of customers would recommend the audit/rating to someone else irrespective of DAC status or program. However, 5 to 10% of customers in a non-DAC would not recommend the Home Energy Score Pilot or Pearl Certification Pilot program rating, whereas no customers in a DAC would not recommend the Home Energy Score Pilot or Pearl Certification Pilot program rating. The Residential Energy Assessment Program had the highest proportion (about 10%) of customer that would not recommend the audit, irrespective of DAC status.

Figure 2-7. Audit/rating recommendation summary by DAC status



3 Findings and Recommendations

This section presents the findings and recommendations that the team identified as part of this study. The team offers five findings and five recommendations based on the impact evaluation research.

3.1 Finding 1

Overall customers reported being very satisfied with their experience with these programs reporting overall satisfaction levels between 4.0 and 4.3 out of 5 for each of the three programs. The areas that received the lowest scores from the customer satisfaction portion of the survey were with the quality and value of recommendations and with the thoroughness of the report.

3.1.1 Recommendation 1

Evaluators recommend that the program provide additional tools and training that could help contractors develop consistent and thorough recommendations. This training could cover the most common, or important from a program perspective, types of energy efficiency measures, what information the auditors should be collecting in the homes, and what information should be included in the report to the customers. Many of the contractors have expertise and focus on one area; however, training could give them more education on all of the different measures that the program wants to have recommended. It could also help contractors focus on certain areas that may be of interest to the program in the future, such as electrification.

Initial NYSERDA Response to Recommendation:

Implemented. NYSERDA introduced a new energy auditing tool and program platform in July 2023. One of the benefits of the new auditing platform is ensuring consistency among all audit reports and notations if key components were missing from recommendations. Training on the tool was completed for all participating contractors and ongoing training opportunities are available. NYSERDA will continue to monitor the uptake of the new auditing platform and look for areas of continuous training and support.

3.2 Finding 2

About 20% of the contractors identified that they participate in several NYSERDA programs that offer energy audits in addition to the Residential Energy Assessments program, and that while all programs require collection of the same or similar customer and building data, each program has

its own required data collection forms and processes. These contractors identified this as an inefficiency that increases the paperwork and administrative burden on contractors to manage multiple processes.

3.2.2 Recommendation 2

Collaborate across audit and rating programs to standardize data collection and administrative processes. Consider adopting a common data collection form and/or process for core customer and/or building information with opportunities to supplement with program-specific data needs.

Initial NYSERDA Response to Recommendation:

Implemented. With the implementation of the new program management platform and audit tool in July 2023, NYSERDA standardized the data collection and report for the Residential Energy Assessment and EmPower+ programs. The Comfort Home pilot will be brought into that platform in 2024 and work is underway to standardize the processes when it can be done.

3.3 Finding 3

The evaluated MAR for the REA fossil measures is 38%, statistically significantly lower than the program assumption of 46%. However, the MAR from this study may be somewhat understated since many of the survey respondents had received the audit less than two years prior to the survey. The evaluated MAR for the REA electric measures is not statistically significantly different from the program assumption.

For the pilots, the evaluated MAR for audits delivered by contractors was slightly higher than the program assumption of 45%, but the result for inspectors was well below the program assumption of 30%. However, the MAR from this group of homeowners may be somewhat understated since many of the survey respondents had received the audit less than two years prior to the survey and were in the process of buying the home at the time of the audit.

3.3.3 Recommendation 3

Retain the current MAR assumptions for the Residential Energy Assessment program, and re-evaluate the MAR in the next round of this study, with more participants who have longer elapsed time since the audit.

For future pilots that rely on inspectors, consider assuming a lower MAR than was assumed for the Home Energy Score and Pearl pilots.

Initial NYSERDA Response to Recommendation:

Rejected. To be conservative in its reporting, NYSERDA will incorporate the 38% MAR rate into its forecasting of impacts from the Residential Energy Assessment Program in 2024, instead of retaining the current MAR assumptions for the program.

3.4 Finding 4

Natural gas realization rates for total savings were 77%, 92%, and 119%, respectively for the REA program, the HES pilot, and the Pearl pilot. For REA, the realization rate lower than 1 reflects the lower than assumed MAR. However, natural gas realization rates will not be applied to reported savings until the completion of Phase 2 of the evaluation, to ensure sufficient confidence and precision in the results of the analysis. Note this evaluation uses an incremental sampling approach which aggregates results over the course of successive phases to reach desired confidence and precision levels over time. For all three initiatives, Evaluation estimates of average recommended savings per home are in line with the program assumptions.

3.4.4 Recommendation 4

No change is recommended to the savings estimates for recommended measures based on this study given prior program adoption of savings calculation changes associated with the move to a common platform (NYHEP).

Initial NYSERDA Response to Recommendation:

Implemented. With the adoption of the new platform in July 2023, the methodology for savings calculations changes was already changed for some measures, to be consistent with the NYS Technical Resource Manual (TRM). No modifications were made to the TRM-based calculations in NYHEP as a result of the evaluation.

3.5 Finding 5

Electric realization rates from this study were not found to be meaningful.

3.5.5 Recommendation 5

For the next evaluation round for this program, consider further steps to exclude effects of fuel switching on both electric and natural gas savings. Also consider steps to include a larger number of homes in the billing analysis to improve the reliability of these savings estimates.

Initial NYSERDA Response to Recommendation:

Rejected. For the next evaluation period, NYSERDA will seek to better understand the effects of fuel switching, rather than excluding fuel switching from the analysis.

4 Methods

4.1 Measure Adoption Rate (MAR)

Primary data collection relied on social science methods including surveys, interviews, and sampling approaches to collect data on the current and evolving state of the market. The Impact Evaluation Team developed and conducted a survey of participant end-users' energy efficiency measure adoption and savings. NYSERDA collaborated with the Impact Evaluation Team during the development of the survey instrument.

Surveys, either conducted as phone interviews or web-based surveys of Home Energy Score, Pearl Certification, or Residential Energy Assessment recipients, were used to determine the MAR. The team implemented an incremental sampling approach for this evaluation, described in more detail in Section 4.3. This initial evaluation focused on assessing the MAR for Home Energy Score or Pearl Certification ratings conducted between 2019 and 2021, and for Residential Audit Program Audits between 2020 and 2021. Because these energy ratings and audits are ongoing and because future updates to this study will be needed to evaluate them, the team also proposed an incremental sampling methodology to determine the MAR for Home Energy Score, Pearl Certification, and Residential Energy Assessments moving forward for projects completed up until 2024. This study also evaluated energy savings for homes supplied by delivered oil, propane, and other fuels.

The team completed a background review of program and historic evaluations conducted for these initiatives to date. The team is familiar with the two prior evaluations, as their author.

4.2 Sampling

There are three different participant populations within this study. For the two pilot programs, due to the lower number of participants, the team attempted a census with the survey, meaning all participants were contacted. This approach did not require a separate sample design. Additionally, no sampling was done for the consumption analysis, only for the MAR survey.

For the Residential Energy Assessments Program, the team designed a sample to target the desired 90/10 confidence/precision level required for the survey. The sample was designed to optimally allocate 1,500 sample points across the population stratified by fuel type, program year, and program tracking savings targeting at a minimum ±10% relative precision at the 90% level of confidence for the program. The study required about 450 completes to achieve those targets, assuming a 30% response rate for the survey required drawing a total sample of 1,500. An

assumed error ratio of 1.0 was used for the sample design for all fuel types and program years. A minimum sample size of 5 sample points was assigned to any cell in the sample design which results in a census of "Other" fuel type. The "Other" fuel type category was established for sites with fuel types including coal, wood, and pellets. Only 10 "Other" fuel type customers are in the program across the 2020–2021 study years.

A summary of the sample design by fuel type can be seen in Table 4-1, followed by a summary of the total target completes and the expected relative precision.

Table 4-1. Sample design by fuel type

Fuel	Program Year	Participants	Combined Savings (MMBtu)	Error Ratio	Sample
Natural Gas	PY_2020	1,223	61,455	1	500
Natural Gas	PY_2021	1,450	74,075	1	600
Natural Gas	**Total**	**2,673**	**135,529**	**1**	**1,100**
Electricity	PY_2020	75	1,661	1	50
Electricity	PY_2021	89	2,022	1	50
Electricity	**Total**	**164**	**3,683**	**1**	**100**
Oil	PY_2020	205	11,356	1	90
Oil	PY_2021	165	10,359	1	80
Oil	**Total**	**370**	**21,715**	**1**	**170**
Propane	PY_2020	91	3,684	1	55
Propane	PY_2021	79	3,106	1	55
Propane	**Total**	**170**	**6,790**	**1**	**110**
Other	PY_2020	10	176	1	10
Other	PY_2021	10	383	1	10
Other	**Total**	**20**	**559**	**1**	**20**
Total	**Total**	**3,397**	**168,277**	**1**	**1,500**

Table 4-2. Target completes and expected relative precision

Program Year	Fuel	Participants	Combined Savings (MMBtu)	Error Ratio	Target Completes	Expected Relative Precision at 90% Confidence
2020	Natural Gas	1,223	61,455	1	150	12.5%
2021	Natural Gas	1,450	74,075	1	180	11.4%
Total	**Natural Gas**	**2,673**	**135,529**	**1**	**330**	**8.4%**
2020	Other	381	16,877	1	62	21.3%
2021	Other	343	15,870	1	59	21.9%
Total	**Other**	**724**	**32,748**	**1**	**121**	**15.3%**
Total		**3,397**	**168,277**	**1**	**451**	**7.4%**

4.3 Customer Decision Making

In addition to the primary data collection activity described in Section 4.1, the survey instruments included research questions necessary to understand the adoption of home energy efficiency measures and barriers to adoption of energy efficiency measures recommended in the energy audit or rating. Additionally, the survey instruments were designed to understand the impacts of COVID-19 on LMI communities regarding opportunities, barriers, and impacts. Survey instruments can be found in Appendix A.

4.4 Process Evaluation

Process evaluation is included as a part of this evaluation study on a given program or intervention based on the theory of change outlined in the logic model constructed by NYSERDA as part of its investment planning process. The Impact Evaluation Team reviewed the program logic model hypotheses and conducted a process evaluation through program document review, customer surveys, and contractor surveys to provide actionable recommendations to improve programs that could be implemented for quick-cycle feedback and in support of continued program refinement. The issues addressed included: 1) program efficiency and effectiveness; 2) participant satisfaction with the audit process, report, home energy rater/inspector performing the audit, and measure performance if they adopted the measure; 3) suggestions for improvement; 4) barriers to participation or measure adoption; and 5) improvements in audit program contractors' sales processes and business models as a result of offering energy ratings or the residential energy assessments.

4.5 Impact Evaluation

The team performed a pre-post analysis with site-level weather-normalized change analysis with a matched comparison group for each participation cohort. The comparison group was drawn from homes that had not participated yet for the full analysis period for that cohort (future participants). Future participants are expected to be substantially similar to current-year participants, but not to have major changes related to the program during the current participants' pre-post analysis period. The site-level analysis provides many advantages for exploring savings by program year and by participant characteristics of interest.

4.6 Two-Stage Modeling with Comparison Groups

Comparison group development. In this step, the Impact Evaluation Team identified comparison cases for each participant from future participants. For each participant, the team set

the pre-participation period as the 12 months before the audit, and the post-participation period as the 12 months after the reported date of the last measure installed. The team also identified one or more comparison homes. A comparison home is a home that was a participant in a later year, whose participation window (audit date through last installation date) does not overlap with the participant home's pre through post periods. That is, the comparison home had not yet participated across the entire pre-post span. For example, a home participating in January 2021 and completing installations in June 2021 could have 2020 as its pre period and July 2021 through June 2022 as its post period. The same home could serve as a comparison home for a participant with 2020 as its post period and July 2018 through June 2019 as its pre period. For this analysis, comparison homes were matched by utility groups. RG&E was grouped with NYSEG and National Fuel, upstate utilities with a small number of participants. Similarly, Orange and Rockland was grouped with Consolidated Edison, both downstate. National Grid participants were matched within National Grid. In future versions of this analysis, comparison homes may be matched on other characteristics, such as size and measures recommended. Matching on recommended measures means, for example, that a home that installed recommended insulation is compared with a home that similarly had that upgrade recommended (future participant comparison home).

Site-level modeling. The team constructed weather-normalized annual consumption for each pre- and post-participation period for participants and their comparison group members. For each 12-month analysis period for each home and fuel (electricity, natural gas, delivered), the team fit a degree-day model with customer-specific optimized degree-day base, and used the estimated model to calculate normalized annual consumption (NAC). The normal-degree-day period was used per current NYSERDA guidance on the appropriate normal-degree-day period, consistent with recent evaluation work such as the RTEM evaluation.