

Comfort Home Impact and Process Evaluation

Final Report

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Acronyms and Abbreviations

NYSERDA	New York State Energy Research and Development Authority
QA/QC	Quality Assurance and Quality Control
NYHEP	New York Home Energy Portal
BPI	Building Performance Institute
CAS	Combustion Appliance Safety
NYSEG	New York State Electric and Gas
RGE	Rochester Gas and Electric
ConEd	Consolidated Edison
EUI	Energy Usage Intensity
DiD	Difference-in-Differences
ADC	Average Daily Consumption
HDD	Heating Degree Days
CDD	Cooling Degree Days
NCDC	National Climatic Data Center
CZ	Climate Zone
RR	Realization Rate

Executive Summary

In 2019, New York State signed the Climate Leadership and Community Protection Act (Climate Act) to address climate change threats. The Climate Act, effective January 1, 2020, established energy savings and carbon reduction goals, including 100% carbon-free electricity generation by 2040, and at least an 85% reduction in emissions compared to 1990 levels. As part of its effort to advance toward a carbon-neutral economy, the New York State Energy Research and Development Authority (NYSERDA) launched the Comfort Home Pilot (hereafter referred to as Comfort Home or Comfort Home Program). The Comfort Home Program aims to create a strong market for the transition to heat pumps. Comfort Home provides incentives for installing building shell improvement packages designed to reduce homes' heating and cooling loads in preparation for heat pump installation, and offers pathways for customers to install heat pumps.

ES.1 Introduction

The Comfort Home Program offers incentives for implementing standard load reduction packages, primarily focused on envelope improvements. There are three load reduction packages: A (“Good”), B (“Better”), and C (“Best”). The program also seeks to educate customers about heat pump technologies and connect interested participants with qualified heat pump installers. Participating contractors either deliver both envelope improvements and heat pump installations or focus solely on envelope upgrades to prepare the home for a future heat pump installation, after which they could refer the customer to a qualified air source or ground source heat pump installer.

To assess the program's effectiveness, NYSERDA engaged Opinion Dynamics and its partner, West Hill Energy and Computing (collectively referred to as “the evaluators” or “the team”), to conduct an evaluation of the Comfort Home Program. This evaluation covers 1,939 households that participated between January 2020 and April 2023 and includes two components: an impact evaluation and a process evaluation. The impact evaluation focuses on estimating energy savings and developing realization rates and energy savings as a percent of baseline energy consumption. This current report covers natural gas and electric savings only. The evaluation of savings from homes with delivered fuel heating systems (oil, propane, and kerosene) is currently in progress.

The process evaluation examines how contractors implement Comfort Home, explores customer and contractor experiences, assesses participant outcomes, and identifies key factors influencing customers' decisions to adopt heat pump technologies.

ES.2 Key Findings

1. **During the evaluation period, the Comfort Home Program achieved total first year energy savings of 20,660 MMBtu including natural gas and electric.**^{xvi} Natural gas savings account for approximately 95% of these electric and natural gas program savings. These results represent deep energy savings and reduced baseline heating consumption by up to 20%, depending on which program package was chosen. Across all fuels, natural gas represents 68% of all savings; ongoing evaluation studies will capture the impact related to the remaining delivered fuels population.

- a. **Recommendation:** Revisit the program’s incentive structure to ensure incentives are aligned with the energy savings potential of measures. In particular, incremental incentives for installing windows in Package C may be misaligned with their savings potential.

NYSERDA Response to Recommendation: Implemented. Package C has been renamed to “Windows Add-on” and the available incentive has been reduced to a lower value than the other two Package offerings.

- b. **Recommendation:** To facilitate access to the necessary data required for future impact evaluations, NYSERDA should continue to enforce the requirement that contractors collect and submit consent forms. The evaluation team understands that NYSERDA’s efforts with recent Comfort Home projects have a high consent form compliance rate (95% in 2024). Use a consistent file naming format (such as Last name <Space> First name) to make it easier to locate already collected consent forms.

NYSERDA Response to Recommendation: Pending. NYSERDA will consider implementing a required file naming convention for contractors uploading customer consent forms.

2. **The realization rate of natural gas savings was 66%, indicating room for improvement in the accuracy of program-estimated savings.**^{xvii} Sub-group analysis suggests the program energy savings modeling algorithms are more reliable for inefficient homes and tend to overstate savings for more efficient homes. [make note here or in an end note about not applying electric RR]

- a. **Recommendation:** Review and improve program algorithms to enhance program-estimated savings estimates for more efficient homes.^{xviii}

NYSERDA Response to Recommendation: Implemented. NYSERDA has transitioned from the NY Technical Resource Manual Custom Measure Category 5 to Custom Measure Category 6 to model estimated savings. This updated savings methodology requires more inputs and is expected to result in more accurate energy savings predictions.

3. **The Process Evaluation revealed that Comfort Home contractors were highly satisfied with the Comfort Home program’s simplicity, including its streamlined processes, minimal paperwork, and user-friendly workflow platform.** While these aspects currently set it apart from other incentive programs, contractors expressed concern that upcoming changes to workflows would introduce inefficiencies to the processes and undermine the strengths of the program. Additionally, while contractors receive initial onboarding training, there was a lack of ongoing training, particularly on customer education. This results in wide variability in how heat pumps are presented, potentially leading to missed opportunities for customer education and heat pump adoption.

- a. **Recommendation:** Maintain the program’s streamlined workflow and minimal paperwork requirements. If changes are needed, gather contractor input and provide clear training and support to avoid added complexity or confusion.

NYSERDA Response to Recommendation: Implemented. NYSERDA intends to maintain Comfort Home’s streamlined processes.

- b. **Recommendation:** NYSERDA, in coordination with NYS Clean Heat and other stakeholders, should determine what, if any, heat pump communication should take place through Comfort Home. If contractors will be expected to deliver or support heat pump messaging, materials and training should be made available. This could include creating or leveraging existing training modules on the long-term benefits of heat pumps and customer engagement strategies or leave-behind materials contractors can give to customers after the upgrades are complete.

NYSERDA Response to Recommendation: Pending. NYSERDA will consider the extent of heat pump communication Comfort Home contractors will be expected to provide to customers in line with broader electrification efforts statewide.

4. **Most customers who participated in Comfort Home reported improved home comfort and lower energy bills, particularly among those who installed heat pumps.** Adoption of heat pumps was driven largely by environmental motivations and was more common among higher-income households, those using delivered fuels, or those with solar PV. However, the high upfront cost remains a barrier for many, especially middle-income households who may not qualify for low-income support but still find current heat pump incentives inadequate.

a. **Recommendation:** Provide learnings and recommendations to NYS Clean Heat program administrators as well as NYS Joint Utility program administrators who are designing regional market-rate weatherization programs to enhance incentives for households earning under \$200,000. Even if heat pump incentives fall outside of Comfort Home’s future program structure, learnings from the program could inform the design of more effective incentive structures and support improved heat pump affordability and adoption.

NYSERDA Response to Recommendation: Implemented. NYSERDA is providing learnings and recommendations to NYS Clean Heat program administrators and NYS Joint Utilities market-rate weatherization programs.

1 Introduction

1.1 Program Description

The Comfort Home Program seeks to make homes heat pump ready by providing incentives for installing “seal and insulate” load reduction packages, educating customers about heat pumps, and referring interested customers to a heat pump installer.¹ The program offers three standard packages:

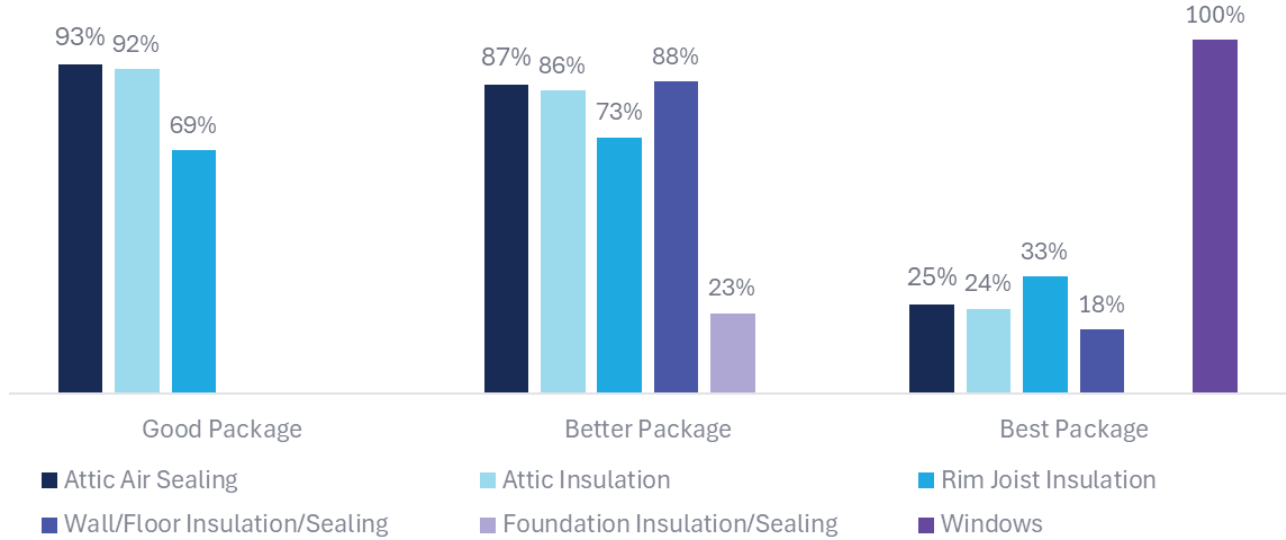
- Package A (Good): Air seal attic, insulate attic, and/or seal and insulate rim joists. Customers must install at least one of these improvements, and the end condition of the home must meet minimum envelope performance criteria as stipulated in the program requirements for all these aspects.
- Package B (Better): Option to either insulate above grade walls and floors to achieve 100% insulation of wall and floor area, or insulate the basement foundation walls to extend at least 18 inches below exterior grade level. This package also includes sealing and insulation of various interstitial spaces found in homes that can contribute to heat loss and air infiltration and projects that redefine the thermal envelope of the home by moving the air and thermal barrier from the ceiling to the roofline to “bring the attic inside.”
- Package C (Best): Replace windows with new ENERGY STAR® or equivalent windows so that the end condition of the home has a minimum of 80% ENERGY STAR® rated windows.

Similarly, to be eligible for Package C, homes must meet Package A and B requirements.

Figure 1 displays the percentage of homes that had each measure installed as part of their Comfort Home package installation.

¹ NYSERDA. *Comfort Home Pilot Program Program Manual*. April 2024.

Figure 1. Installation Rates for Measures Across Packages



Contractors referring customers who complete any of the above packages to a qualified heat pump installer are eligible for an additional heat pump referral incentive. To qualify, the heat pump must be installed within 24 months of the standard load reduction package completion. These incentives are paid to the contractor, who may choose to pass them on to the customer. Incentive amounts for all packages and heat pump referrals during the evaluation project period are listed in Table 1 below.

Table 1. Comfort Home Incentive Amounts (as of July 1, 2024)

Package	Envelope/ Load Reduction Incentive	Heat Pump Referral Incentive
A (Good)	\$1,600	\$1,000
B (Better)	\$3,000	\$1,500
C (Best)	\$4,000	\$2,000

Comfort Home enables an innovative service model that reduces the contractor’s customer acquisition costs and sales cycle times and can help lower costs to the customer. The approach is designed to encourage customers to invest in a clean energy heat pump solution after being presented with an affordable improvement package that addresses their primary motivation/interest (e.g., lowering heating and cooling costs, minimizing fossil fuel use, maximizing use of solar power, improving home heating and cooling, or desiring to use a clean heating system to combat climate change).

The Program is designed for market-rate customers, and NYSERDA encourages income-eligible customers to seek assistance through other programs such as EmPower+. The objectives of the Comfort Home Program are as follows:

- Encourage customers to make efficiency improvements for greater comfort and reduced energy use in their homes.
- Install air sealing, insulation, and ENERGY STAR® windows in the home, preparing it for heat pump installation by reducing heating and cooling loads to enable use of smaller capacity equipment.
- Support best practices in delivering clean energy heat pump solutions.
- Reduce the soft costs and project cycle times historically associated with the delivery of residential energy efficiency incentive programs.

1.2 Summary of Evaluation Objectives and Methods

This evaluation includes both impact and process evaluation components for 1,939 households that participated in the program between January 2020 and April 2023. The evaluation objectives are:

Table 2. Comfort Home Evaluation Objectives

Objective	Purpose	Method
Evaluate energy impacts	Determine energy savings for natural gas, electricity, and delivered fuels, including gross energy savings and energy savings as a percent of baseline energy consumption	Billing analysis of energy bills
Develop realization rates	Determine the ratio of evaluated savings to program-estimated savings (realization rate)	Billing analysis and comparison to program-estimated savings
Conduct subgroup analysis	Determine characteristics that are correlated with higher energy savings.	Billing analysis of energy bills
Study contractors' implementation of the program	Examine the extent to which contractors are implementing the program as intended by NYSERDA	Contractor interviews
Understand customer and contractor program participation experiences	Identify program strengths and areas for improvement based on contractor and participant experiences	Contractor interviews Participant survey
Learn about customer outcomes from program participation	Identify perceived impacts of the program	Participant survey
Explore influences on heat pump adoption	Examine factors supporting and barriers impeding heat pump adoption after program participation	Contractor interviews Participant survey

2 Methods

2.1 Impact Evaluation

The evaluation team used consumption analysis to estimate the direct energy savings impact of the Comfort Home Program. The following sections describe the data sources and methodology for natural gas and electric impacts. At the time of reporting, the delivered fuel data collection was underway. Delivered fuel impacts will be provided in subsequent reporting.

2.1.1 Data Sources

The evaluation team used the following data sources:

- Program tracking data, provided by NYSERDA, that included customer identifiers, participation dates, installed program measures, program-estimated energy savings, and housing characteristics.
- Customer consent forms authorizing the release of customer consumption data from the utilities and delivered fuel dealers.
- Monthly and bi-monthly utility gas and electricity consumption data provided by the utilities.²
- Weather data from the closest stations across New York State, including actual and typical weather conditions.

Table 3 presents the distribution of consumption data availability for participants with natural gas heating and electric services. Overall, the program tracking data included 1,328 participants with natural gas heating and 1,939 with electric service. Of the electric service participants, 142 were identified as using electricity as their primary heating fuel. However, consent forms were only able to be obtained for 875 participants with natural gas heating (or 66%), 1,201 with electric service (62%), and 96 with primary electric heat (68%). The Team requested consumption data for those participants from the utilities.

A set of thorough data cleaning steps was completed to address missing or duplicate records, issues of estimated reading, abnormal billing periods, extreme consumption values, and insufficient billing history.³ Ultimately, 411 homes were included in the natural gas consumption analysis (31% of all participants with primary natural gas heating and 57% with gas billing data received from the utilities). In the electric consumption analysis, 563 homes were included in the consumption analysis, which

² Natural gas consumption data was obtained for National Grid, NYSEG, National Fuel, RGE, Central Hudson, and ConEd. Electricity consumption data was obtained for National Grid, NYSEG, RGE, Central Hudson, and ConEd.

³ Please see Appendix A for detailed data cleaning steps.

represents about 56% of the participants with billing data received from utilities. However, only 30 of the 142 participants with electric heating (21%) remained in the modeling dataset.⁴

Table 3. Participation and Consumption Data Availability

	Natural Gas Heat		Electric Service		Electric Heat	
	Number	% of Total	Number	% of Total	Number	% of Total
Total Participants	1,328	100%	1,939	100%	142	100%
Participants with Consent Form	875	66%	1,201	62%	96	68%
Participants with Utility Consumption Data	715	54%	998	52%	81	57%
Participants Included in Model	411	31%	563	29%	30	21%

2.1.2 Analyses

The Comfort Home Program provides building shell measures that reduce heating and cooling energy use (packages and measures described in detail in Section 1.1). Participating homes have natural gas, electric, or delivered fuel heating and might have electric cooling. As such, the natural gas analysis estimated heating savings only, while the electric analysis attempted to estimate heating and cooling savings. The evaluation applied two-way fixed effects Difference-in-Differences (DiD) type regression models to estimate household-level savings. This is an industry-standard approach when evaluating changes in energy consumption for programs with rolling participation dates.⁵

To obtain insights into the drivers of savings, the evaluation team analyzed savings for various subgroups. These subgroups were determined in collaboration with NYSERDA and are based on participant characteristics such as package type, DAC status, climate zone, utility, house size, home vintage, heating system type, baseline consumption, and energy use intensity (EUI). Table 4 below presents the subgroups and their definition.

⁴ For residential impact evaluations, drop rates of 40% to 60% due to data cleaning are typical.

⁵ Agnew, K.; Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68564. <http://www.nrel.gov/docs/fy17osti/68564.pdf>

Table 4. Subgroup Analysis

Characteristics	Subgroups	Subgroup definitions
Package	A-Good, B-Better, C-Best	Whether a participant was classified as receiving package A, B, or C.
DAC Status	DAC vs Non-DAC	Whether a participating home is in a DAC.
Climate Zone	Climate Zones 4, 5, and 6	Climate zone of the participating home. ⁶
Utility	National Grid, ConEd, NYSEG, Central Hudson, RGE	Electricity/natural gas utility of the participant. Due to a lack of participants, utilities with fewer homes in the model were grouped in the natural gas analysis.
House Size (Square Feet)	Small, medium, large, and very large	Electricity: Small ($\leq 1,300$ sq ft), Medium (1,301 – 2,200 sq ft), Large (2,201 – 4,000 sq ft), Very Large ($> 4,000$ sq ft) Natural gas: Small ($\leq 1,300$ sq ft), Medium (1,301 – 2,200 sq ft), Large/Very large ($>2,201$ sq ft); large and very large were combined due to the small number of homes.
Household Vintage	Pre-War Development, Post-War Boom, Energy-Efficient Era, Modern Construction	Electricity: Pre-War Development (1900 – 1939), Post-War Boom (1940 – 1969), Energy-Efficient Era (1970 – 1989), Modern Construction (1990 – 2010) Natural gas: pre-war, post-war, modern (1980+); the Energy-Efficient Era and Modern Construction were combined due to the small number of homes.
Pre-period Baseline Consumption	Divided into quartiles based on Average Daily Consumption (ADC)	Electricity: Low: 10–16, Moderate: 17–23, High: 24–32, Very High: ≥ 33 kWh Natural gas: Low: 0.74 - 2.04, Moderate: 2.05–2.68, High: 2.69–3.64, Very High: ≥ 3.65 therms
EUI (Energy Usage Intensity)	Divided into quartiles based on baseline ADC per square foot	Electricity: Very Low: 0 – 0.009, Low: 0.010 – 0.013, Moderate: 0.014 – 0.018, High ≥ 0.019 kWh per square foot Natural gas: Very Low: 0 – 0.0011, Low: 0.0012 – 0.0014, Moderate: 0.0015 – 0.0019, High: ≥ 0.0020 therms per square foot.
Heating System	Boiler, Furnace	Natural gas only: Whether the home is heated with a boiler or a furnace.

⁶ Climate Zone Map: https://www.data.ny.gov/api/views/6vh9-pjst/files/rUQX7ltjv36QyMNV4O9eTiw7twZgvCHL-RbjPTDMBmw?download=true&filename=Climate_Zone_Map.pdf

2.1.2.1 Natural Gas Analysis

The natural gas consumption analysis quantified the weather-normalized per-household natural gas savings for program participants with natural gas consumption and program reported savings. The savings were estimated using pooled, cross-sectional, time series models, interrupted at the time of the installation. All models included customer-specific intercepts (fixed effects). The following models were tested:

- Model 1: Model with Heating Degree Days (HDD) and program intervention (referred to as “household model” hereafter)
- Model 2: Model 1 plus time variables
- Model 3: Model 1 plus Comfort Home packages added (referred to as “package model” hereafter)

The output and statistical properties of the three models were compared, and Model 3 was selected as the final model for the reasons described below:

- The results from Models 1 and 2 were virtually the same, indicating that the time variables were not improving the ability to estimate savings
- Model 3 was selected over Model 1 model because the R^2 is higher, the average savings are almost identical to those of the model, the relative precision for the program savings estimate is better, and the package model provides key information about the program performance.

The package model (Model 3) was used to estimate the total program evaluated savings. As the Comfort Home measures are designed to lower heating consumption, the expected natural gas savings are heating-related, and the household savings were calculated from the coefficients associated with the changes in the heating portion of the model. The total evaluated program savings were calculated by multiplying the program-estimated savings for the package by the RR for the package; this approach accounts for variations between the homes in the model and all program participants.

The subgroup models were implemented by adding indicator variables to the Model 1 regression to estimate the annual energy savings by subgroup. The regression outputs for the subgroups were compared to determine whether subgroups are statistically different using four metrics: annual energy savings, baseline annual heating consumption, RR, and/or energy savings as a percentage of the baseline annual heating consumption.

Further analysis was conducted to investigate the possible underlying factors. For example, if the RR for Package A is substantially higher than the RR for the other two packages, the subgroup analysis for another category, such as boilers and furnaces, may appear to have statistically different RR, but the actual reason for the difference could be that the incidence of homes with Package A is higher within homes with boilers than for homes with furnaces. This process involved comparing the percent of homes with Package A vs Packages B and C in each of the other subgroups to identify the root cause of the differences in RR.

2.1.2.2 Electric Analysis

Similar to the natural gas analysis, consumption analysis was used to estimate weather-normalized per-household electric savings. The model included customer and time-period-specific fixed effects to control for unobserved individual characteristics and time trends that affect electricity consumption. In addition, the team used actual Cooling Degree Days (CDD) and Heating Degree Days (HDD) and electric heating and cooling flags to control for weather and heating/cooling technology-dependent changes in energy consumption. The Comfort Home Program's ongoing operation, where participants can join the program at any time throughout the year, rather than having to wait for a specific date, makes participants later in the evaluation period a natural comparison group for participants earlier in the evaluation period. For the electric model specifically, the evaluation team limited modeling to data through to the end of March 2023, allowing participants treated in April 2023 to serve as a comparison group that was never treated during the modeling process.

The initial analysis included all participants with program reported electric savings and was designed to capture overall savings, including heating and cooling savings. However, as noted above, only 142 participants (approximately 7% of all participants) used electricity as their primary heating fuel, and 101 of these had a consent forms, allowing the evaluation team to request their electricity consumption data from the utilities. After data cleaning, only 30 participants with electric heating remained in the modeling dataset.

Given the small number of participants with primary electric heating, consumption analysis could not detect statistically significant electric savings (i.e., the confidence interval included 0). As such, the evaluation team estimated electric heating and cooling savings separately. Cooling savings were estimated by comparing how the post-treatment energy consumption varied between the treatment and comparison groups in instances where CDD was positive. Savings were weather-normalized using TMYx weather data to estimate program impacts under normalized conditions.

Since the consumption analysis did not result in statistically significant electric heating savings, the evaluation team used an alternative analysis approach, based on a combination of program-tracking data and results from the natural gas and electric cooling consumption analyses, using Equation 1.

Equation 1: Per Participant Electric Heating Savings

$$\text{Electric Heating Savings} = \text{Evaluated Natural Gas Savings As \% of Baseline Heating Consumption} \times \text{Evaluated Baseline Electric Heating Consumption}$$

The first term, *Evaluated Natural Gas Savings as a % of Baseline Heating Consumption*, is a direct output of the natural gas consumption analysis (see section 3.1.1). The second term, *Evaluated Baseline Electric Heating Consumption*, on the other hand, was not directly available from the electric consumption analysis, given that the electric heating model only included 30 participants with electric heat. Instead, the evaluation team developed this term, using the following three steps:

Step 1: Estimate the program-estimated baseline electric heating consumption. The program-tracking data includes total baseline electric consumption and whether a participating home has electric heating and/or electric cooling systems. The data does not report separate electric heating and cooling baseline consumption. The team calculated electric heating consumption as the difference between the average program-**estimated** baseline electricity consumption of homes with and without primary electric heat.

Step 2: Develop a baseline adjustment factor. The program-estimated electric and natural gas consumption is higher than the evaluated baselines from consumption analysis. To account for this

difference, the evaluation team estimated an adjustment factor by dividing the evaluated baseline electric consumption (based on the electric consumption analysis) by the average program-estimated baseline for participants included in the electric consumption analysis.

Step 3: Develop the evaluated baseline electric heating consumption. The evaluated baseline electric heating consumption was obtained by multiplying the estimated program-estimated baseline electric heating consumption from Step 1 by the adjustment factor from Step 2.

While admittedly an imperfect method, made necessary by data limitations, this approach makes use of actual consumption observations and evaluated results to the extent possible. The evaluation team believes that the approach provides a reasonable estimate of electric heating savings for the following reasons:

- The Comfort Home Program provided similar measures/package upgrades to homes with electric heating and homes with natural gas space heating.
- The measures provided target energy savings in the same end-use, namely, space heating.
- Evaluated natural gas savings are based on similar homes in similar geographic regions and come from the installation of similar measures.
- The evaluation team estimated baseline electric heating consumption values by taking into account the relationship between program-estimated baselines and evaluated baselines from the electric consumption analysis.
- The estimates obtained are within the range of typical electric savings compared with other programs with similar measures.

2.2 Process Evaluation

2.2.3 Primary Data Collection

For the process evaluation, the evaluation team conducted interviews with Comfort Home contractors and administered an online survey to Comfort Home participants. See Appendix B and C for the interview guide and survey instrument, respectively.

2.2.3.1 Contractor Interviews

During the evaluation period, a total of 39 contractors completed one or more Comfort Home projects. The evaluation team utilized a purposive sample to select twenty contractors in four stratification groups. The evaluation team stratified the sample by project volume (high and low) and Quality Assurance and

Quality Control (QA/QC) rating (high and low). To determine high and low volume, the team reviewed contractor project counts from 2020-2022, which ranged from 1 to 205 projects. The team designated the top third of contractors (those completing 30 or more projects) as “high volume” and the remainder as “low volume.” QA/QC ratings were available for 30 of the 39 contractors who completed a Comfort Home project. Based on these, contractors with a perfect rating of 5 out of 5 were categorized as “high QA/QC,” and those rated below five were considered “low QA/QC.”

All twenty contractors received prenotification emails from NYSERDA to alert them that the evaluation team would reach out to schedule interviews. Following these prenotification emails, the team conducted two waves of email outreach and completed eleven in-depth interviews, resulting in a 55% response rate. Table 5 shows the population, sample frame, and final sample by stratification group.

Table 5. Contractor Interview Stratification Group Sample Size

Stratification Groups	Population	Sample Frame	Sample
High Project Volume & High QA/QC Rating	6	5	3
High Project Volume & Low QA/QC Rating	7	5	3
Low Project Volume & High QA/QC Rating	12	5	2
Low Project Volume & Low QA/QC Rating	5	5	3
Total	30	20	11

2.2.3.2 Participant Survey

The evaluation team also conducted an online survey of program participants using the Qualtrics platform and targeted 1,972 participants who completed their Comfort Home projects between January 2020 and April 2023. The survey included questions about satisfaction with the program, outcomes, and heating fuel use before and after participation in the program.

The survey aimed for a census of the 1,972 participants with email addresses in the program-tracking data. Respondents were invited via email, with up to two reminder emails sent to encourage participation. To boost response rates, respondents were offered a \$10 e-gift card incentive to complete the survey. A total of 128 respondents completed the survey, including 25 who had installed a heat pump following their Comfort Home upgrade, for a response rate of 7.1%.

2.2.4 Analyses

The contractor interviews ranged between 25 and 60 minutes. The wide range in duration is due to additional questions asked of contractors who installed heat pumps, which typically extended the length of those interviews. Following the interviews, the team conducted qualitative analysis of the transcripts

using NVivo qualitative analysis software with a combination of deductive and inductive coding to identify topics that directly addressed research questions and identify emergent themes.

The evaluation team analyzed survey responses using SPSS and Crunch quantitative software packages. Due to the program's focus on heat pump readiness, the team conducted sub-group analyses for respondents who installed a heat pump after participating. The team used Z-tests to identify any significant differences between heat pump adopters and non-adopters, aiming to explore potential variations in comfort, health, and energy-related behaviors post-upgrade. Results with a p-value of less than 0.1 were considered statistically significant. Due to the small sample size of heat pump adopters (n=25), the evaluation team takes caution drawing conclusions from this group.

Additionally, the team conducted t-tests to identify any significant differences in mean thermostat set points before and after Comfort Home participation. Cohen's d was calculated to determine effect sizes for the significant results.

3 Results

3.1 Impact Evaluation

The total natural gas and electric program savings are presented in Table 6. A separate analysis for delivered fuel savings is underway. During the period from January 2020 through April 2023, the first year annual savings for homes that participated in the Comfort Home Program was 20,660 MMBTU across both fuels. Natural gas accounts for most program energy consumption savings (95%). Homes with natural gas as the primary heating fuel saved a total of 19,533 MMBtu in gas heating consumption, with a realization rate of 66% and a relative precision of 8% at the 90% confidence level. Total electric savings were calculated by combining cooling-related savings from consumption analysis and heating-related savings estimated using the alternative approach described above. They amounted to 1,127 MMBtu with a realization rate of 49%.⁷ The realization rate across natural gas and electricity savings was 65%.

Table 6. Total Program Savings

	Number of Participants	Total Program-Estimated Savings		Total Evaluated Savings		Realization Rate
		MMBtu/Year	% of Total Fuel	MMBtu/Year	% of Total Fuel	
Package A – Good	778	13,500	46%	10,847	56%	80%
Package B – Better	399	14,170	48%	7,569	39%	53%
Package C – Best	151	1,978	7%	1,117	6%	56%
<i>Total Natural Gas Heat</i>	<i>1,328</i>	<i>29,648</i>	<i>100%</i>	<i>19,533 (+/-1,609)</i>	<i>100%</i>	<i>66%</i>
<i>Total Electric</i>	<i>1,939</i>	<i>2,284</i>	<i>100%</i>	<i>1,127</i>	<i>100%</i>	<i>49%</i>
Total Program	1,939	31,932		20,660		65%

3.1.1 Natural Gas Savings

This section covers natural gas savings estimation and subgroup analysis.

⁷ Of the total electric savings, electric cooling savings account for 62% and electric heating savings account for 38%. Electric heating savings were estimated by applying natural gas savings as a percentage of baseline to the estimated electric heating baseline. Given this methodology, the evaluation team could not estimate the relative precision or confidence intervals for total electric savings.

3.1.1.1 Model Results

The two top candidate models are described in Table 7 below. Baseline heating consumption and average savings are similar for the household and package models. The package model was selected as the main model since it provides better model fit, lower relative precision, and additional information about program performance.⁸

Table 7. Comparison of the Candidate Natural Gas Models

	Adjusted R ²	Baseline Annual Heating Consumption (MMBtu/yr)	Evaluated Annual Savings per Household (MMBtu/yr)	Realization Rate (RR)	Relative Precision of the RR
Household Model	0.795	86.6	12.7	66%	12%
Package Model	0.813	86.8	12.7	66%	9%

Table 8 shows the average household savings, RRs, and savings as a percentage of the evaluated baseline heating consumption by package type. Evaluated savings per home vary significantly, with Package B showing the highest savings at 16.2 MMBtu/year, while Package C has the lowest at 5.5 MMBtu/year. However, the realization rate is highest for Package A at 80%, suggesting that the reported savings closely match the evaluated savings for Package A. In contrast, Package B and Package C have a lower realization rate of 53% and 56%, respectively. Savings as a percentage of baseline heating consumption also varied substantially, with 20% for Package B, 14% for Package A, and 8% for Package C. These variations, in combination with the subgroup analyses discussed in the following subsection, provide insights into possible reasons for the different RRs.

Table 8. Natural Gas Average Evaluated Savings per Home from the Package Model

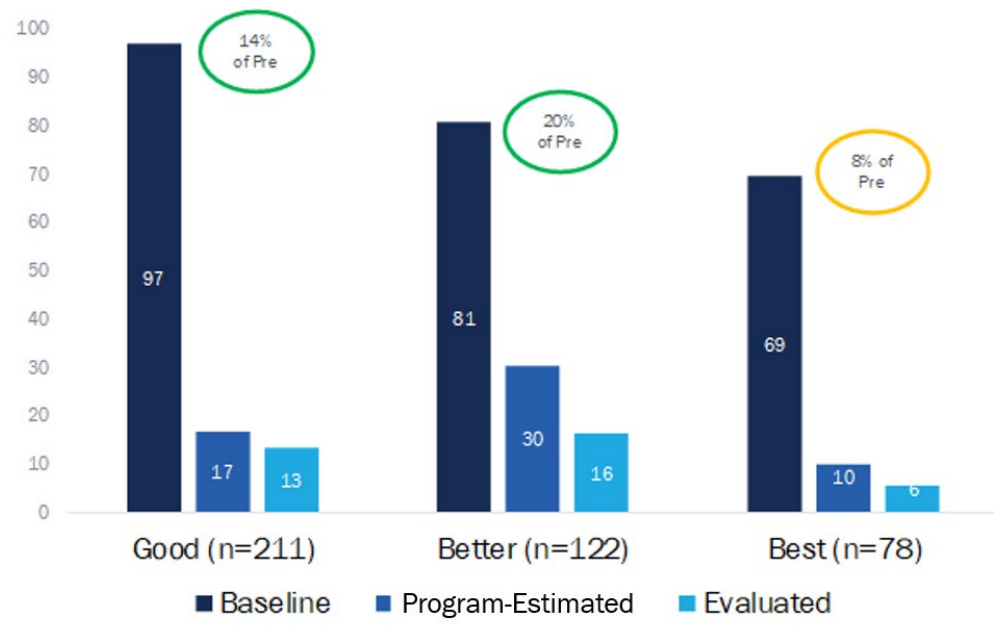
	Homes in the Model	Average Program-Estimated Savings per Home	Average Evaluated Savings per Home	Realization Rate	Evaluated Savings as Percent of Evaluated Baseline Heating Consumption
Package A - Good	211	16.7	13.4	80%	14%
Package B - Better	122	30.3	16.2	53%	20%
Package C - Best	78	9.7	5.5	56%	8%
All Homes	411	19.4	12.6	66%	15%

⁸ The adjusted R² is the coefficient of determination from the regression and is a measure of the goodness-of-fit. The adjusted R² of 0.813 for the package model is higher than the model (0.795).

The analysis below compares the program-tracked and evaluated savings to the evaluated baseline. The program database also includes an estimate of the baseline natural gas use. For the 411 homes included in the natural gas model, the program-estimated baseline was 50 to 60% higher than the evaluated baseline. The program-tracked savings as a percent of the program-estimated baseline use are close to the evaluated savings as a percentage of the evaluated baseline use.

Figure 2 compares the evaluated baseline heating consumption, program-estimated and evaluated savings, and RRs for the packages in a visual format. The baseline is the evaluated baseline from the models, and all savings are in MMBtu. Package B is a primary contributor to the RR for the program, as it accounts for almost half of the total program-estimated savings. While the RR for Package C is similar, the average program-estimated savings and number of participants are substantially lower, resulting in a smaller impact on the program savings.

Figure 2. Baseline Heating Consumption, Program-Estimated and Evaluated Savings, and RRs by Package



The package-wise analysis points to specific characteristics of the packages and the accuracy of the program-estimated savings, as discussed in Table 9. Package A (Good), with its much higher realization rate of 80%, indicates more accurate program-estimated savings. Package A homes are also the least efficient with the highest baseline heating consumption. Package B (Better) shows the highest evaluated savings, though its realization rate is the lowest at 53%, suggesting overestimated program-estimated savings. The average evaluated baseline use for Package B homes was 17% lower than Package A, suggesting that the Package B homes, on average, were moderately more efficient before participation.

Package C (Best) has the fewest participants. Package C, which was designed to encourage the selection of incrementally better windows when replacement windows are being installed, included homes that were most efficient pre-upgrade and mainly included replacement windows only, resulting in lower savings.

Table 9. Natural Gas Savings and Differences in Characteristics of Projects with Different Packages

Package	Baseline Heating Consumption & EUI	Program-Estimated Savings vs. Evaluated Savings	Key Observations
A (Good)	Highest, indicating that the homes are least efficient.	More accurate	There were more package A recipients with the highest EUI (i.e. had the least efficiency at baseline.) Less efficient homes had an RR closer to 1, indicating that program-estimated savings were closer to evaluated energy savings for these homes.
B (Better)	Moderate	Overestimate	Highest evaluated savings; comprehensive installations.
C (Best)	Lowest	Overestimate	Fewest participants; most efficient homes pre-upgrade; many received window replacements only.

The Comfort Home Program is achieving savings within the range of other programs of this type offered in the Northeast and higher than found in recent evaluations of other similar programs in the Northeast. Package B achieved both the highest evaluated savings and has the lowest RR, suggesting that while the program implementation is successful, the method of estimating savings for this package is overestimating the actual savings.

3.1.1.2 Subgroup Analyses

The subgroup analysis was designed to assess whether there are patterns among subgroups that may help to explain the evaluation results. We do so by comparing the RR and evaluated savings of different subgroups. The main findings from the subgroup analysis are summarized below.

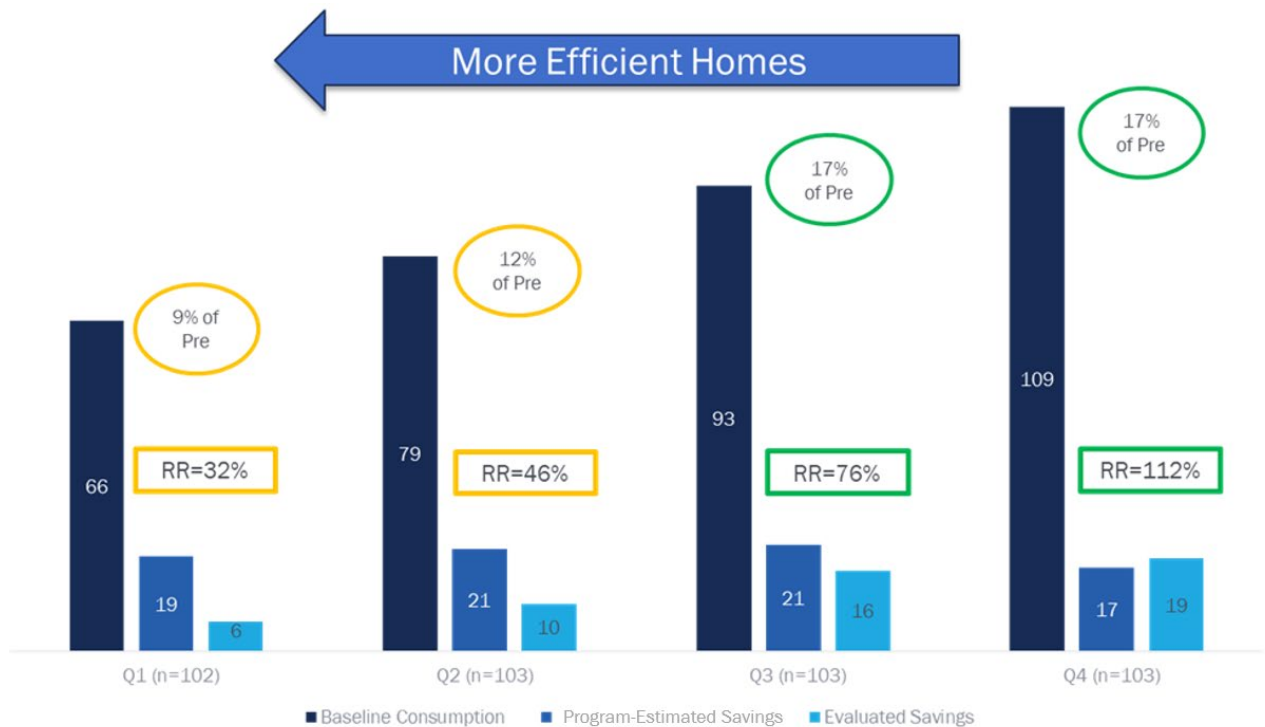
- The percentage of homes with Package A is strongly correlated with a high RR within specific subgroups. Due to the incentive structure, Package A homes are highly likely to be less efficient prior to program participation than Package B or C homes.
- Program-estimated savings seem to be more accurate for homes that were inefficient prior to participation (higher EUI), older homes (pre- or post-war), and homes with high baseline heating consumption.

- Variations in the RRs from other subgroup comparisons are more likely to be related to the main factors discussed above than to the specific subgroup.

Adjusting the program algorithms to better account for the participation of more efficient and newer homes could improve the accuracy of the program-estimated savings.

For these purposes, the EUI was calculated to reflect the efficiency of the home prior to the measure installation. Homes were divided into quartiles from lowest (Q1) to highest (Q4) EUI. This subgroup analysis shows a strong trend, with the RR increasing as the efficiency decreases. That is, the least efficient homes (Q4) have the highest RRs and the highest baseline use. The savings as a percent of the evaluated baseline consumption is the highest for Q3 and Q4 at 17%, dropping to 9% for the most efficient homes (Q1). This trend is illustrated in Figure 3.

Figure 3. Subgroup Analysis by EUI Quartile

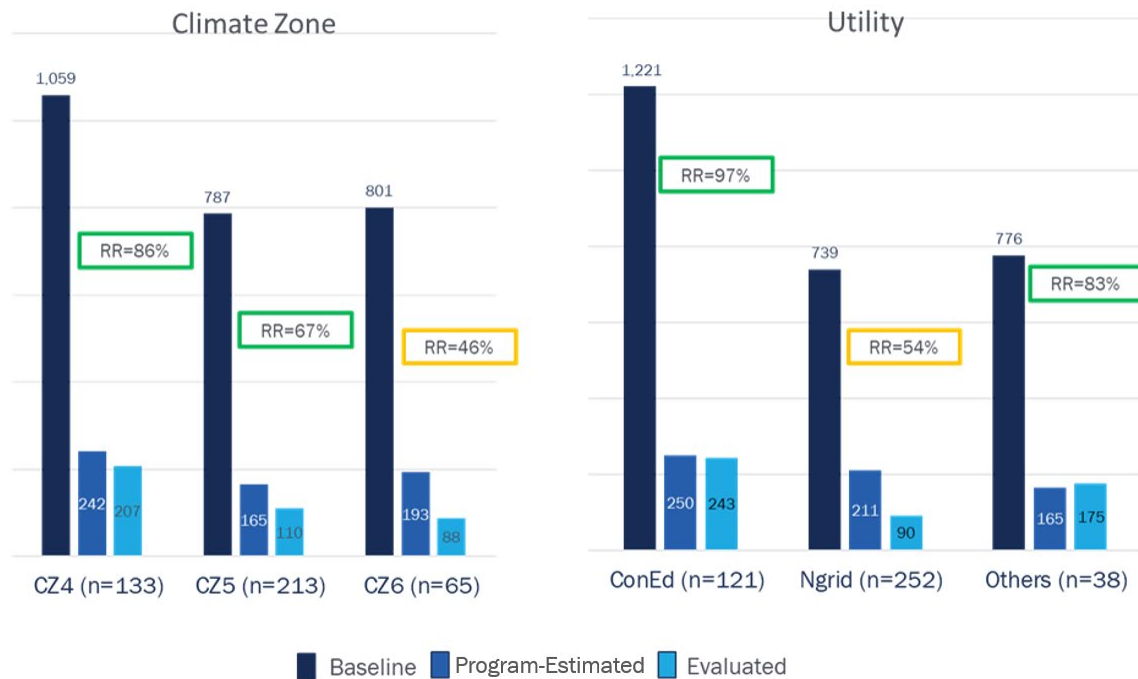


The results for the subgroup analyses based on climate zone (CZ) and utility territory are closely related. Figure 4 shows the results for these two subgroups. Multivariate analysis which considered both the percentage of homes which installed Package A and the average EUI in each subgroup category, however, suggests that results in Figure 4 are more likely to be driven by these confounding variables than the subgroup categories themselves. These considerations are discussed below.

- The percentage of projects which installed Package A is 71% for CZ4, 38% for CZ5, and 55% for CZ6, which is likely a major factor contributing to the higher RR for CZ4.
- CZ4 has the mildest climate but the highest baseline heating consumption, which is counterintuitive.
- ConEd is most of CZ4.
 - About 70% of ConEd homes received Package A, as compared to 40% for National Grid.
 - ConEd homes are substantially larger (50% large/very large as compared to 15% for other utilities), which is likely to be contributing to the high baseline heating consumption.
 - Program staff report that most of these homes are in Westchester County, where the program has a disproportionately high project volume, and the contractors target higher-income households with larger homes.

These results suggest that the housing stock and Package A shares are more likely to be driving the RRs than the climate zone or utility.

Figure 4. Subgroup Analysis by Climate Zone and Utility



The findings from the other subgroups are summarized in Table 10. The distribution of participants among the packages seems to be driving many of the results from the subgroup analyses; the RR for

Package A is substantially higher than the other two packages, and the percentage of homes with Package A in a subgroup is strongly correlated with the RR for that subgroup.

Table 10. Summary of Other Subgroup Findings

Subgroup	Findings
Community Type DAC v Non-DAC	<ul style="list-style-type: none"> Differences are not statistically significant for any estimators, and RRs are similar. Homes in DACs have lower savings and lower baseline use, proportional to non-DAC. Package A was installed in a lower percentage of DAC than non-DAC homes (39% DAC and 53% non-DAC).
Baseline Consumption By Quartile, with Q1 being the lowest energy consumption quartile.	<ul style="list-style-type: none"> Homes with the lowest baseline consumption also had the lowest RR and savings as a percentage of baseline heating consumption. While baseline heating use is directly correlated with EUI, the trend is not as strong as found with the EUI quartiles. For example, the savings and RR for Q2 and Q3 are very close. The percentage of homes with Package A was highest for Q4 (72%) as compared to 37% for Q1/Q2, which is likely to contribute to the high Q4 RR (97%).
House Size Small, Medium, Large & Very Large	<ul style="list-style-type: none"> The patterns for savings and baseline consumption are consistent across home size: both increase with home size. The RRs are not statistically different, although the large/very large homes RR is the highest of the three (68%). Large/very large homes have a higher percentage of Package A installations (64% compared to 41% for small homes).
Heating System Boiler vs. Furnace	<ul style="list-style-type: none"> 70% of homes with boilers were Package A, as compared to 42% for furnaces, which is likely to be driving the difference in RR (75% for boilers versus 62%). While the difference in annual savings is statistically significant, the RRs are not due to the high variability among homes with furnaces.
House Vintage Pre War, Post War, Modern (1980+)	<ul style="list-style-type: none"> MMBtu savings are not statistically different. The evaluated savings as a percentage of the baseline consumption are about the same. The difference in the RR, however, is statistically significant between pre-war/post-war and modern homes. The issue seems to be with the estimation of savings. While the program-estimated savings for modern homes are 31% lower than those for pre-war homes, the difference in the evaluated savings is only 13%, suggesting that the program may be estimating the savings more accurately for older, less efficient homes.

3.1.2 Electric Savings

The evaluation team estimated three household-level models to assess overall evaluated electric savings, including both heating and cooling savings. They are as follows:

- Model 1** controlled for differences in weather using cooling and heating degree days, while also using customer fixed effects to control for time-invariant differences across participants and time-period fixed effects to control for general changes in electricity consumption patterns over time, observed across all customers in the model.

- **Model 2** built on Model 1 and estimated how electricity savings varied depending on weather conditions after program participation.
- **Model 3** added an additional layer to Model 2 by controlling for how weather-dependent electricity consumption differs across homes with and without electric cooling and space heating.

The results of the three models are presented in Table 11. All three models indicated small, statistically insignificant increases in overall electric consumption.

Table 11. Electric Models Results

Model	Adjusted R ²	Baseline Annual Consumption (kWh)	Evaluated Average Annual Savings (kWh)	Percent Savings	Low Confidence Interval	High Confidence Interval	Statistical Significance
Model 1	0.65	9,159	-75.8	-0.83%	-434.9	283.3	No
Model 2	0.65	9,157	-112.2	-1.22%	-471.7	247.4	No
Model 3	0.66	9,204	-61.9	-0.67%	-415.9	292.1	No

While the overall impacts in Model 3 were insignificant, the model did detect a statistically significant reduction in *cooling* consumption and a statistically insignificant increase in heating consumption. Given the strong model fit (Adjusted R-squared of 0.66), the likely explanation for the non-significant overall results is the wide confidence intervals of heating savings due to the limited sample size (n=30). As such, the evaluation team developed separate estimates of heating and cooling savings, summarized in the following subsections.

3.1.2.1 Electric Cooling Savings

Electric cooling savings were estimated by using the coefficients of the interaction between program participation and CDD in the final model. Thus, the estimate compares how post-treatment consumption varies with CDD before and after treatment, after controlling for (1) how weather affects electricity consumption in general, (2) in homes with electric space cooling and heating, general trends in consumption, and (3) differences in time-invariant customer characteristics that affect electricity consumption. The savings estimates are then normalized using TMYx weather data.

Table 12 presents the estimated, per-household electric cooling savings. The consumption analysis detected a statistically significant cooling program impact, with average evaluated household savings of

105.5 kWh per year (± 91 kWh at 90% confidence), representing approximately 1.1% of total household baseline consumption.

Table 12. Electric Cooling Modeled Savings Per Household

Model	R2	Baseline Annual Consumption (kWh)	Evaluated Average Annual Cooling Savings (kWh)	Cooling Savings as Percent of Baseline Use	Notes
Model 3	0.66	9,204	105.5	1.1%	Statistically significant cooling savings

3.1.2.2 Electric Heating Savings

After data cleaning, only 30 of the 142 participants with electric heating remained in the modeling dataset. With this limited number of participants, consumption analysis cannot effectively detect electric heating savings. Therefore, the evaluation team estimated electric heating savings using a combination of program-tracking data and results from the natural gas and electric cooling consumption analyses (see Section 2.1.1).

Using Equation 1, the team estimated annual per-household electric heating savings of 886 kWh, as follows:

Annual per-Household Electric Heating Savings

$$= \text{Evaluated Natural Gas Savings As \% of Baseline Heating Consumption} \times \text{Evaluated Baseline Electric Heating Consumption}$$

$$= 14.7\% \times 6,066.5 \text{ kWh}$$

$$= 886 \text{ kWh}$$

The team used the following three steps to estimate the *Evaluated Baseline Electric Heating Consumption* per household (see Table 13):

Step 1: The team first estimated the program-estimated baseline electric heating consumption among homes with electric heat (8,792 kWh) as the difference between average reported electricity consumption in homes with and without electric heat.

Step 2: The team estimated an adjustment factor of 0.69 by dividing the evaluated baseline consumption from the consumption analysis described above by the average program-estimated baseline consumption of the homes included in the consumption analysis.

Step 3: The adjustment factor was applied to the program-estimated baseline electric heating consumption to obtain the evaluated baseline electric heating consumption of 6,066.5 kWh.

Table 13. Electric Heating Consumption Per Household

1. Estimated Program-Estimated Baseline Electric Heating Consumption			2. Adjustment Factor			Evaluated Baseline Heating Consumption
A	B	A - B	C	D	C/D	(A-B) x (C/D)
Average consumption in homes with electric heat	Average consumption in homes without electric heat		Evaluated baseline consumption	Program-estimated baseline consumption in all homes	Adjustment Factor	

3.1.2.3 Program Electric Savings

Electric program savings were mainly driven by cooling-related impacts, with an average savings of 105.5 kWh per participant across all customers with electric services, totaling 204,565 kWh. Among the 142 participants with primary electric heating, the average electric heating savings was 886.1 kWh per participant, adding another 125,825 kWh in heating-related savings, resulting in total program electric savings of 330,390 kWh.

Table 14. Program Electric Savings

Fuel Type	End-use	Per-participant Savings (kWh)	Number of Participants	Total Electric Savings (kWh)	Total Electric Savings (MMBtu)
Electric	Cooling	105.5 a	1,939	204,565	698
	Heating	886.1 b	142	125,825	429
Total				330,390	1,127

^a Per-participant with electric services from an IOU.

^b Per-participant with electric heat.

3.1.2.4 Subgroup Analysis

The evaluation team examined how evaluated electric cooling savings vary between the different subgroups described in Section 2.1.2. The evaluation team estimated Model 3 for the different subgroups separately. No consistent patterns or significant differences in electric cooling savings were found across

the various subgroups. This is likely due to the relatively small cooling savings amidst highly variable overall electricity consumption. Thus, segments are typically not large enough to reliably detect savings and differences within them.⁹

3.1.3 Conclusions and Recommendations

Based on the consumption analysis results, the evaluation team has the following conclusions and recommendations:

Conclusion 1: During the evaluation period, the Comfort Home Program achieved total first year savings of 20,640 MMBtu (including natural gas and electric savings).

Conclusion 2: Natural gas savings account for approximately 95% of the program savings, excluding the savings from homes heated with delivered fuels. The Comfort Home Program demonstrated strong performance in reducing natural gas use, with per-household gas savings of 19.4 MMBtu/year, ranking among the highest observed in similar programs across the Northeast. Electric savings accounted for a smaller portion of overall energy savings (5%) and were primarily driven by cooling savings. On average, participants realized cooling savings of 105.5 kWh per year (1.1% of baseline consumption). Per-household electric heating savings were higher, estimated at 886.1 kWh annually, but only apply to the small subset of 142 customers who use electric heat as their primary heating source.

Conclusion 3: Package B (Better), which often includes measures from both Packages A and B, achieved the greatest natural gas savings, reducing baseline heating consumption by 20%.

Conclusion 4: The realization rate of 66% for natural gas savings indicates room for improvement in the accuracy of program-estimated savings. Sub-group analysis suggests the program algorithms are more reliable for inefficient homes and tend to overstate savings for more efficient homes.

- **Recommendation:** Program algorithms may be reviewed and improved to enhance savings estimates for more efficient homes. Particularly, Program algorithms should be reviewed to account for the treatment of more efficient and newer homes.¹⁰

Conclusion 5: The incentive structure and package design does not always align with energy savings potential of installed measures such as windows in Package C.

⁹ For each subgroup, the evaluation team also estimated the remainder of the models described in Section 2.1.2.2 as due diligence. In line with the results discussed in 3.1.2, no statistically significant savings were detected for the sub-groups.

¹⁰ NYSERDA's modeling tool and simulation approach are designed to allow for such adjustments. The program uses measured field results to update its modeling approach and improve accuracy over time.

- **Recommendation:** The evaluation team recommends refining the program’s incentive structure to better align with the energy savings potential of low-impact measures such as replacement windows in Package C.

Conclusion 6: Consent forms were unable to be located for a significant share of participants, and available consent forms were difficult to match to the program tracking data. Given that utility and delivered fuel billing data requests often require corresponding participant consent forms, this led to a significant drop in the number of participants included in consumption analyses.

- **Recommendation:** The evaluation team recommends that NYSERDA continues to enforce the requirement that contractors collect and submit consent forms. The evaluation team understands that NYSERDA’s efforts with recent Comfort Home projects have a high consent form compliance rate (95% in 2024). We also recommend using a consistent naming format (such as Last name <Space> First name) to make it easier to locate already collected consent forms.

3.2 Process Evaluation

Specific research questions designed to achieve the objectives of the process evaluation guided the team’s evaluation of the Comfort Home program. The team organized the research questions into key topics: contractor implementation, contractor participation experience, customer participation experience, outcomes, and heat pumps and home electrification. The team’s analysis combined data from the contractor interviews and participant surveys, looking for themes across them to address the research questions and provide a comprehensive overview of the program’s processes and outcomes.

3.2.1 Contractor Implementation

To better understand contractors’ implementation of the Comfort Home program, the team explored contractor training and their delivery of customer education. Interviews suggest contractors’ approach to both staff training and customer education about Comfort Home was limited and informal.

NYSERDA requires contractors to employ at least one full-time staff member with a certification from a list of eight options, including four BPI certification options. **The evaluation team found that most of the participating Comfort Home contractors fulfilled this requirement with Building Performance Institute (BPI) certifications.** Ten contractors indicated that someone on their Comfort Home team possessed either a BPI Building Analyst or Energy Auditor certification. Two contractors reported holding certifications other than BPI, such as the EPA Section 608 Technician Certification and the Air Advice IAQ Specialist Certification.

Most contractors (10 of 11) reported that they did not provide any Comfort Home-specific training for their crews. Typically, one or two staff members were responsible for Comfort Home submissions and would complete the Comfort Home-specific onboarding training. However, the rest of the work crews received a mix of on-the-job training, certification training, manufacturer training, and company-specific training. For example, one contractor said that they provide all new hires with an internal guidebook that is a picture guide showing different types of work offered by the company. Additionally, all contractors employed staff with varying levels of experience and selected team members based on the complexity of each project. For example, over half of contractors (6 of 11) noted that projects involving window installation or spray foam typically required more experienced staff, while newer team members joined simpler jobs and received on-the-job training during installations.

Most (10 of 11) contractors relied on informal verbal education to apprise Comfort Home customers about their home upgrades. This education primarily occurred during the home audit, when contractors explained the audit results and, in some cases, the blower door test results. By the time of installation, most customer education had already been completed as customers decided whether to proceed with the work. **Only two contractors mentioned they provided customers with Comfort Home-specific materials, such as a link to the NYSERDA website or Comfort Home slides.**

The most frequently covered customer education topics were the importance of insulation for improving home energy efficiency (mentioned by 7 of 11 contractors), general information about the Comfort Home packages and incentives (5 of 11), and the purpose and results of blower door tests (3 of 11). Contractors explained that they used the energy audit process to clarify the necessity of the proposed insulation work. One contractor noted,

“We still go through the full audit report and explain why we’re doing a blower door and areas that could be improved in your home. And it’s not really educating them on Comfort Home, but just more so educating them on being more efficient and how their house could be more efficient.”

3.2.2 Contractor Participation Experience

Interviews with contractors provided insights into their experiences with the Comfort Home Program, including the audit and package selection workflow, paperwork requirements, and the challenges they faced. Contractors reported satisfactory experiences with the program overall, voicing appreciation for the relatively streamlined programmatic approach and noting few challenges with the workflow or online platform. Contractors did articulate one challenge: they claim NYSERDA staff sometimes provided inaccurate or misleading information about incentive requirements that made the sales process more difficult.

Contractors generally had positive experiences with the Comfort Home program and had few suggestions for improvement. There were three primary areas of high satisfaction. First, most (9 of 11) contractors were pleased with the streamlined nature of the program from enrollment to submitting projects in the Comfort Home workflow platform, Compass. Second, seven contractors highlighted positive interactions with NYSERDA Comfort Home staff and overall satisfaction with staff support. Finally, five contractors noted they appreciated being able to help customers out by providing incentives. Compared to similar programs, contractors found the paperwork and workflow for Comfort Home audits and package selection straightforward. **Every participating contractor agreed that the amount of paperwork required by Comfort Home was reasonable, and many (9 of 11) said there is much less paperwork than for other incentive and rebate programs.** Most (8 of 11) contractors were highly satisfied with the workflow process. Despite this overall satisfaction, several contractors provided minor suggestions for potential areas of improvement:

- **Suggestion 1:** Adjust the workflow to allow contractors to upload the customer utility release form (URF) to Compass. Currently, contractors must upload this form to a separate SharePoint drive, which sometimes leads them to forget this ‘extra step.’
- **Suggestion 2:** Allow for additional customization in the Compass workflow. Several contractors described struggling to insert home data for homes requiring unique modifications to the Comfort Home packages. For example, one contractor said that the workflow “tends to be a little confusing because if you choose the package you’re doing and you have to modify things on the backside, it doesn’t have a lot of flexibility for that...then you have to go back and remodel it.” Another explained, “it is challenging because you’re relatively limited in what you can say, like attic space one or attic space two. But a lot of times houses can have more than one or two attic spaces.”

Overall, contractors were satisfied with the Compass platform for entering Comfort Home projects and did not support the move to a new platform. Without being prompted by a direct question about this change, seven out of eleven contractors specifically mentioned their opposition to NYSERDA’s plan to switch the Comfort Home assessment and submission process to the new NY Home Energy Portal (NYHEP). One contractor said, “Please encourage [NYSERDA] not to put [Comfort Home] on the NYHEP portal.” Another said, “You can put in big, bold letters that I don’t want to switch to the new portal.” Several contractors had experience using NYHEP from NYSERDA’s Empower+ Program and were able to compare the two platforms directly. While contractors described the current platform, Compass, as seamless and easy to learn, many felt that NYHEP was cumbersome and time-consuming. Specific complaints about NYHEP compared to Compass are listed below:

- Lack of user friendliness: Contractors described Compass as “user-friendly” and “seamless” compared to the “clunky” and “difficult” NYHEP. They said that the Compass workflow process was easy, as data entry fields matched paper documents, and the graphic interface was clear and straightforward. In contrast, they described NYHEP as having a confusing layout with sporadic data entry locations and requirements. Additionally, they mentioned that NYHEP does not track projects well.
- Time consuming: While the Comfort Home energy modeling process takes about ten minutes on Compass, contractors are concerned about the length of time it will take to model Comfort Home projects in NYHEP.

“I think the program that they’re using right now, Compass, works very, very well for what we’re doing with Comfort Home. And I think the other program that they’re considering switching to requires so much more work, a much longer audit process, and a much longer model process. I just don’t think that that would make sense with what we’re being asked to do with Comfort Home.”

Due to this experience with other programs, contractors were under the impression that moving to NYHEP would increase the time needed to complete the Comfort Home workflow.

Comfort Home contractors were also generally satisfied with the support they received from NYSERDA staff. Several contractors (7 of 11) shared that they appreciate the direct, personal communication with program staff, noting that when issues arise, they can easily reach a knowledgeable representative. This accessibility to knowledgeable staff created a sense of trust, allowing contractors to address concerns efficiently. One contractor shared, "It’s helpful when there is a flag or there is an issue, we can reach a human being and explain it with the understanding that like, hey, we’re not trying to be shady, we’re just trying to make sure it’s clear what we’re actually doing."

While contractors were satisfied with their experiences with NYSERDA staff, over half (6 of 11) of contractors were dissatisfied with how NYSERDA communicated to customers about Comfort Home. First, contractors felt NYSERDA did not market the program enough. Since Comfort Home has been operating as a pilot program, budget constraints have limited the reach of its marketing efforts. As a result, four contractors said that they felt NYSERDA’s own marketing efforts were lacking, with one contractor sharing, “I don’t believe there’s been much support on the marketing side.” These contractors felt that NYSERDA could engage more customers by increasing promotion in television or print ads. Additionally, two contractors mentioned that they had a very low volume of leads from the Comfort Home website, and several others were either unaware of these leads or did not utilize them at all.

In addition to lack of marketing, several contractors were dissatisfied with how Comfort Home program staff communicated to interested customers, as they felt like staff were giving people a false impression of requirements for incentives. **Two contractors said that customers often had the false impression that they could easily get free or heavily subsidized windows without doing insulation packages first.**

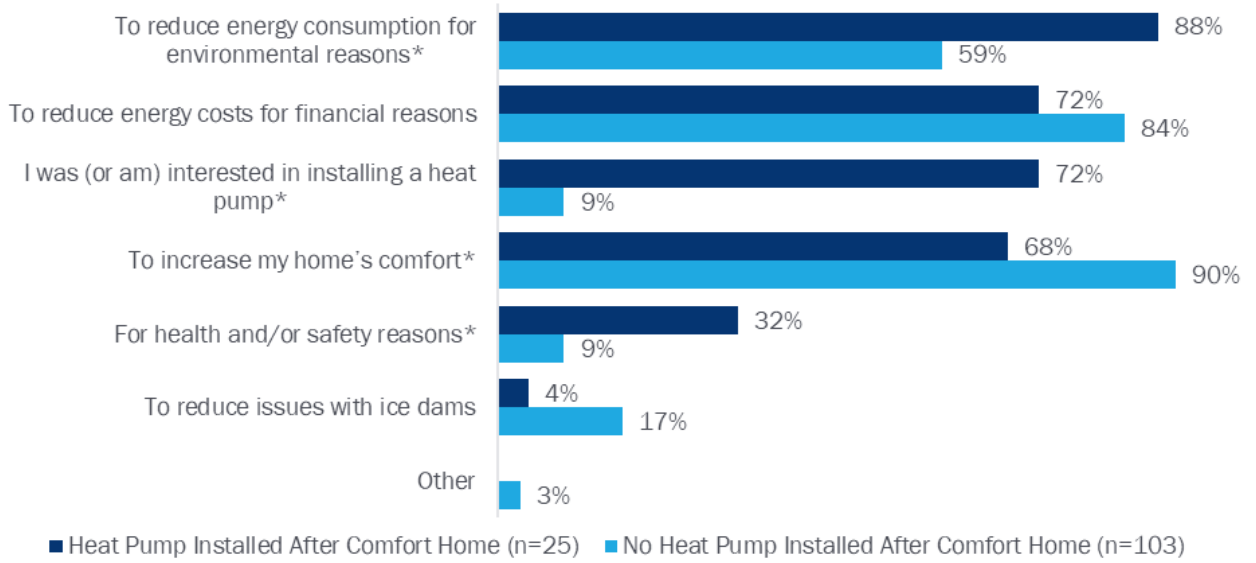
One contractor said Comfort Home program staff “leave it very wide open and then we get there and a lot of times we’re the bearer of bad news. Everyone thinks they’re getting free windows until we get there.”

3.2.3 Customer Participation Experience

The customer survey was the evaluation team’s primary data source about customer satisfaction. Several survey questions asked about customers’ reasons for participating in the program and their experiences in it. Specifically, the team explored their recommendations for program improvements, whether they would recommend the program to others, how they first learned about it, and their interactions with program staff beyond their contractors. The data show customer satisfaction with the program is high, and that contractors play a key role in customers’ program experience, often introducing them to Comfort Home incentives or—in a small number of cases—creating dissatisfaction.

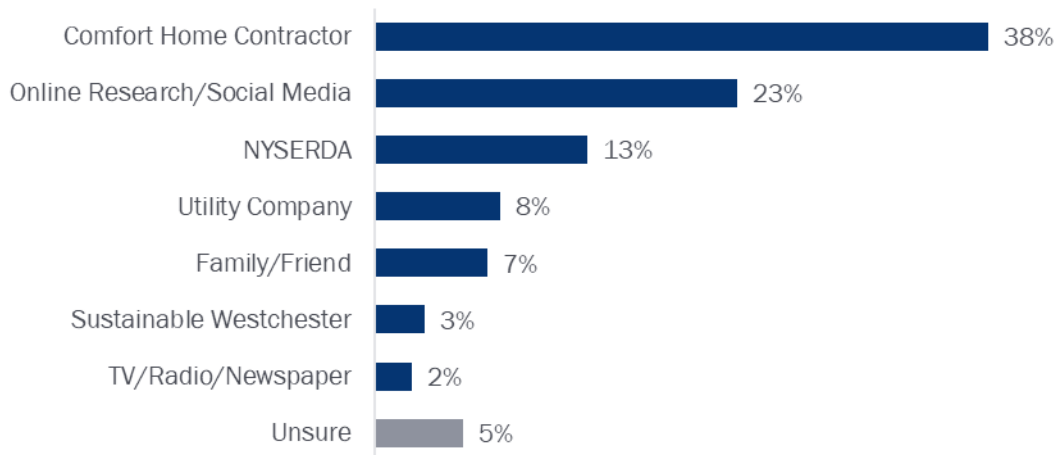
Most respondents indicated they decided to participate in Comfort Home to increase their home comfort (86%) or reduce their energy costs (81%). Respondents who installed a heat pump after Comfort Home were significantly more likely to say health and safety, interest in installing a heat pump, and reducing energy consumption for environmental reasons were primary motivations ($p < 0.1$, indicated by * in the figure). At the same time, they were significantly less likely to say increasing their home’s comfort was a primary motivation ($p < 0.1$) (Figure 5).

Figure 5. Reasons Survey Respondents Decided to Receive NYSERDA Comfort Home Upgrades



The most common way survey respondents reported first learning about Comfort Home was directly from the contractor (38%) (Figure 6). In fact, in response to a different survey question, only 18% of respondents reported interacting with someone from the program other than the contractor. Furthermore, just 13% of respondents learned about Comfort Home through NYSERDA, a significantly lower figure compared to those who heard about it from the contractor. This disparity is consistent with contractors' belief that NYSERDA does not actively promote the program.

Figure 6. How Respondents Learned about Comfort Home (n=128)



The fact that most respondents learned about the Comfort Home program through the contractor highlights contractors' central role in raising awareness of the program. Several contractors (5 of 11) indicated that they use the Comfort Home program as a sales tool to lower the cost of work that customers were already planning to do, suggesting a potential issue with free ridership. Seven out of eleven contractors mentioned that they do not actively market or educate customers about the program. Instead, they simply present it as a rebate after assessing the customer's home needs, using it as an additional incentive to close the deal. One contractor said, "When we are doing an estimate for a customer, we'll introduce them to the program, and usually, they jump aboard". Another shared,

"Offering incentives is very helpful to closing work... We don't educate [customers] about the Comfort Home program at all because it's a rebate, it's not a program, right? So I go in and I assess what the home needs and then I put together a proposal of what they need... and then I say, 'Oh, and there's a rebate and here's what that is.'"

Some survey respondents echoed this sentiment. When asked why they would recommend the program to others, over a third of those who would recommend it (37%) cited the incentives as a primary reason. While many of these respondents said that the incentives helped reduce the cost burden of efficiency improvements, a few (5%) specifically mentioned that the incentives were an added bonus for upgrades they already intended to make. One respondent wrote, "If you're going to do upgrades to your home anyways, you might as well take advantage of the savings that NYS is offering," while another shared, "It's nice to get an incentive for something we were probably going to do anyway."

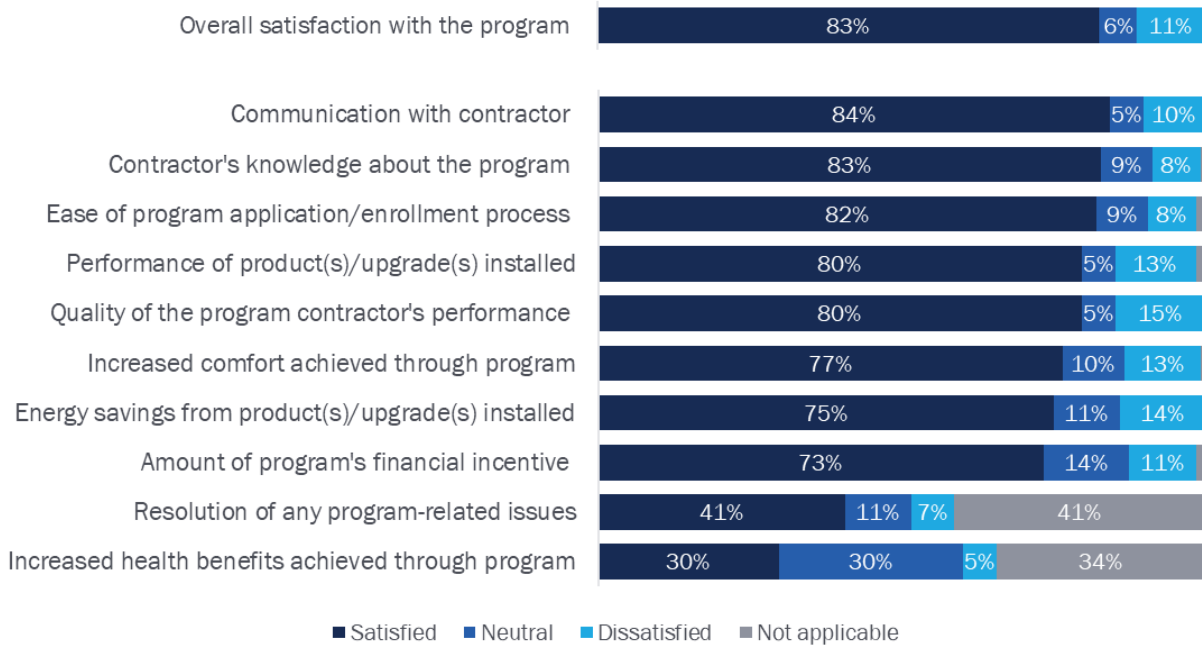
The majority of survey respondents (83%) were satisfied with their overall participation in Comfort Home (Figure 7), and 85% of respondents said they would recommend the program to friends, family, or colleagues. The most common open-ended responses about why they would recommend the program to others were related to the rebate/incentive offered (37%), improved home comfort (25%), and lower utility bills (18%).

Survey respondents' satisfaction with the program varied by program aspect (Figure 7). Only 11% of respondents were dissatisfied with the program overall, and open-ended responses highlighted that the main reasons for dissatisfaction were program outcomes not meeting expectations, contractor performance, and impact on bills. One respondent said, "It promises one thing, but the delivery is something else. And I still have high fuel bills with a completely 'NYSERDA' insulated house and attic." Another simply shared, "The contractors are not qualified."

Two features in the survey were noted as not applicable by respondents: satisfaction with the "resolution of any program-related issues" (41%) and separately, "increased health benefits achieved through the

program” (34%). Typically, an input of ‘not applicable’ implies that respondents did not experience significant health benefits or issues related to the program.

Figure 7. Satisfaction with Specific Aspects of Comfort Home



3.2.4 Implementation Outcomes

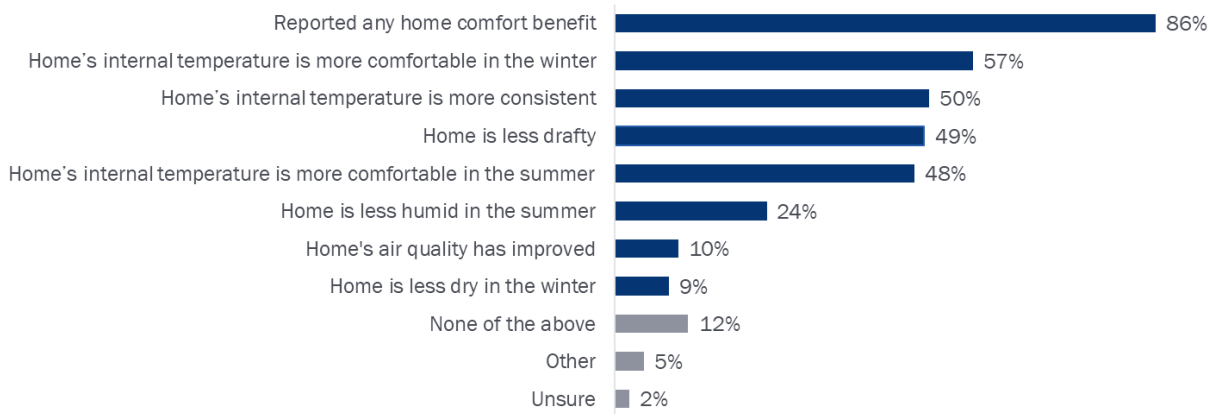
The survey included some items about possible outcomes from Comfort Home participation, including non-energy impacts such as changes in health and home comfort. The evaluation team also explored outcomes related to energy usage, such as changes in energy bills, payment difficulties, and heating fuel use. The program generated positive outcomes for customers, who reported a range of benefits including improved comfort and improved ease paying their fuel bills. Those who installed heat pumps cited additional benefits to air quality and humidity levels. In keeping with NY state decarbonization goals, fossil fuel-using customers reported similar or decreased use of those fuels after the program.

Additionally, the contractor interview addressed outcomes related to customer conversions and timeliness of installations. Almost all contractors reported that at least 20% of customers moved forward with projects after receiving quotes. The average timeline from initial customer contact to package installation was 7.5 weeks, which aligns with Comfort Home’s objective to shorten project cycle times.

The majority of survey respondents (86%) reported at least one home comfort benefit as a result of their Comfort Home upgrades (Figure 9). The most common comfort benefits from the program were

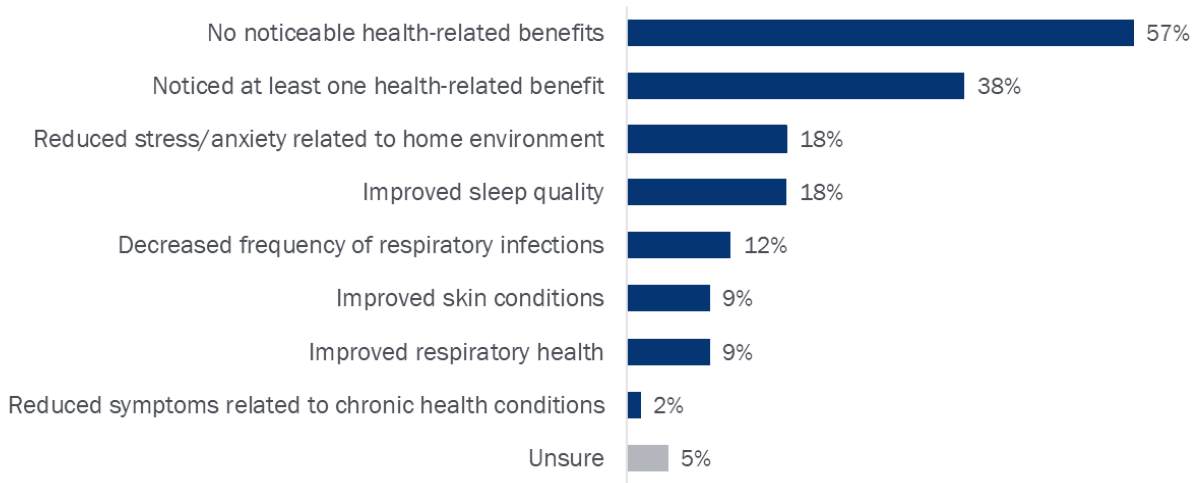
more comfortable temperatures in winter (57%), more consistent internal temperature (50%), less drafty (49%), and more comfortable temperatures in summer (48%). **Respondents who installed a heat pump after Comfort Home were significantly more likely ($p<0.1$) to say their home's air quality improved (24% compared to 7%) and their home was less humid in the summer (40% compared to 20%).**

Figure 8. Home Comfort Benefits from Comfort Home Upgrades (n=128)



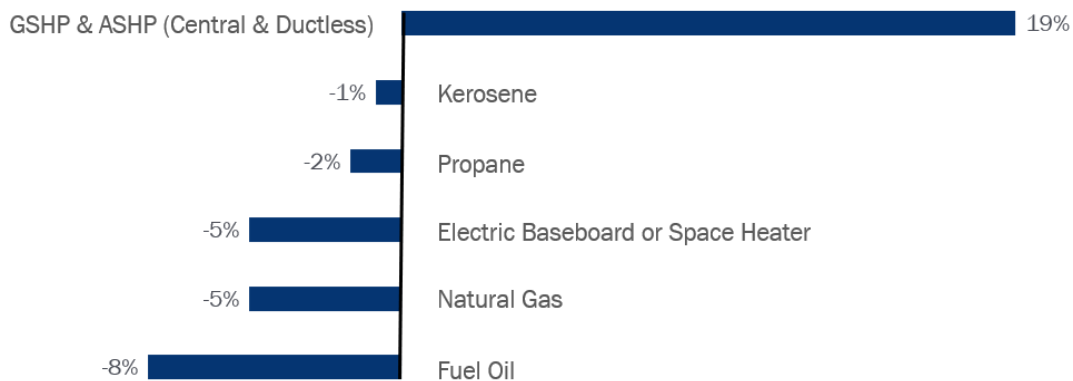
In contrast, the majority of respondents (57%) did not report experiencing any health benefits from Comfort Home (Figure 8). However, of the health benefits mentioned, reduced stress/anxiety related to the home environment (18%) and improved sleep quality (18%) were the most common responses. There were no significant differences in reported health benefits between those who did and did not install a heat pump after participation.

Figure 9. Health Benefits of Comfort Home Participation (n=128)



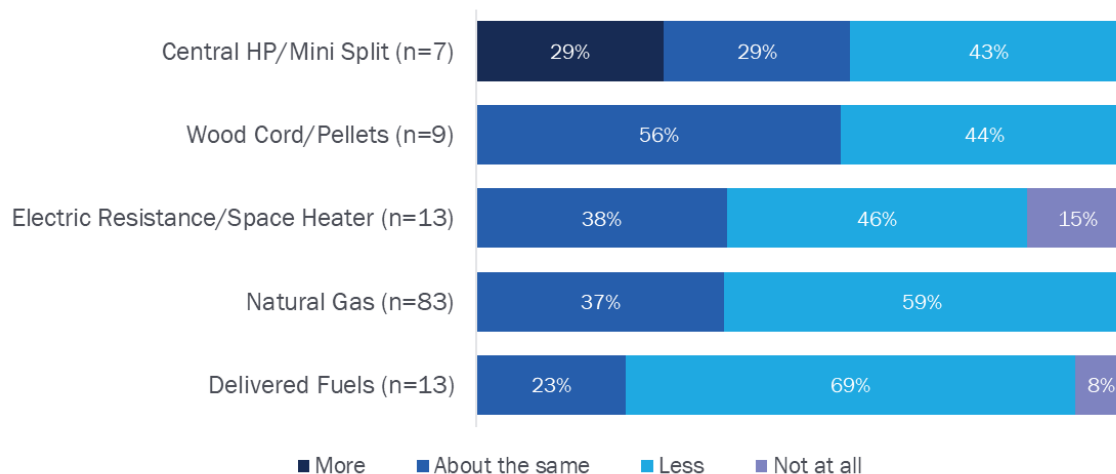
The survey asked participants about the heating fuels they used before and after participating in Comfort Home. **As intended by the program, the share of participants using heat pumps (both ducted and ductless) increased the most, rising by 19 percentage points after program participation.** The share of participants using fuel oil had the greatest decrease, followed by natural gas and electric heating (Figure 10).

Figure 10. Change in Heating Fuel Use (n=128)



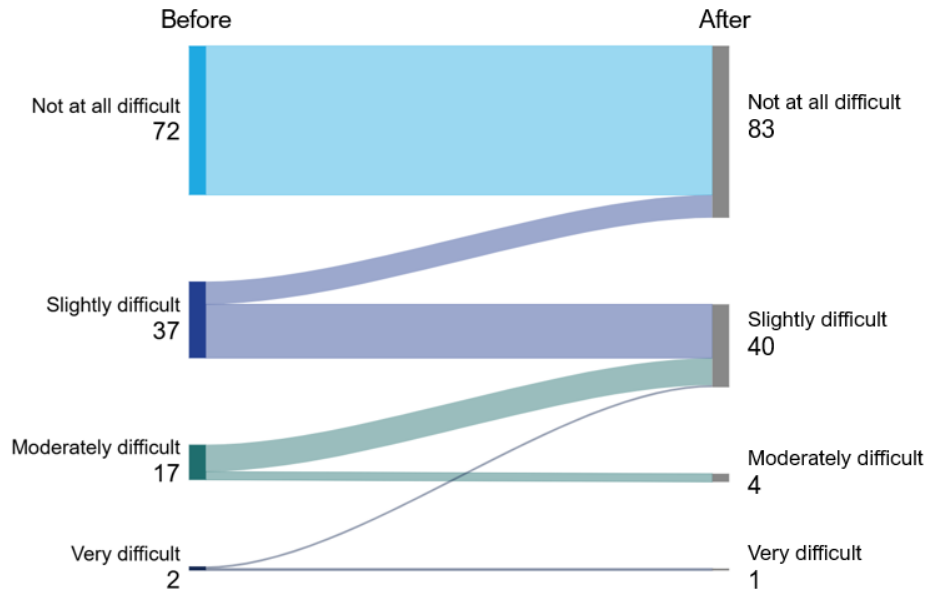
Among the 82% of survey respondents who used the same heating fuel before and after participating in Comfort Home, most (73%) reported that they used their heating system about the same amount or less than before Comfort Home. Figure 11 shows these changes in heating usage by fuel type. **The majority of delivered fuel users (77%) and natural gas users (60%) said they used less of those heating systems or did not use them at all after participation.**

Figure 11. Heating Fuel/System Use After Upgrades (Compared to Before)



In addition to reductions in heating system usage, a majority of respondents (53%) reported that their overall monthly energy bills were lower after receiving Comfort Home upgrades, while 40% of respondents said their bills remained about the same. It should be noted that Comfort Home’s mission as a load reduction pilot program doesn’t always equate to energy bill savings due to variable market prices for energy that are outside the Program’s control. People who did not install a heat pump after participation were more likely ($p < 0.1$) to report that their bills had stayed about the same (45%) compared to those who did install a heat pump (20%). Respondents also generally reported that paying energy bills was easier after participating in Comfort Home, with everyone either reporting the same level of difficulty after participation or less difficulty (Figure 12). More respondents said it was not at all difficult to pay bills after Comfort Home (65%) compared to before Comfort Home (56%). A McNemar-Bowker test indicated that there was a statistically significant shift in reported difficulty paying bills before and after Comfort Home ($p < 0.1$). This suggests that participation in Comfort Home was associated with a meaningful improvement in perceived ease of paying energy bills. Those who installed a heat pump after Comfort Home were significantly more likely ($p < 0.1$) to report that paying bills after participation was not at all difficult (84%) compared to those who did not install heat pump after Comfort Home (60%).

Figure 12. Difficulty Paying Monthly Energy Bills Before and After Receiving Comfort Home Upgrades



In terms of contractor outcomes, the evaluation team examined how the Comfort Home Program has influenced the percentage of market-rate customers who proceeded with projects after receiving bids. **Nearly half (5 of 11) of contractors stated that the program’s focus on market-rate customers filled a gap in the market.** One contractor said, “It’s a good sales tool to help sell projects for customers that are...outside of the low to moderate income that NYSERDA usually focuses on.” Two contractors mentioned that offering these incentives helped them stay competitive, while another two said being a NYSERDA-approved contractor gave them some credibility in the market.

However, the scale of Comfort Home’s impact on conversion rates is closely tied to the availability and size of financial incentives. **At the time of the interviews, most contractors (10 of 11) indicated that 20% or more of customers proceeded with Comfort Home projects after receiving quotes.** Four of eleven contractors said this closing rate was 50% or greater. While several contractors (4 out of 11) reported that this closing rate has remained consistent throughout their time in the program, five others noted that it fluctuated based on the amount of incentives available from Comfort Home and utilities. For instance, one contractor stated, “the higher the incentives, the higher the closing ratio.” Another contractor shared a specific example of how external incentives impacted their conversion rates:

“This time in 2022, I was about at that 30 or 40% conversion mark. Then from May through December last year, 2023, that’s when Con Ed had the \$5,000 rebate, and at that point my conversion rate was like 80%. Almost every house we were walking into we were selling because

people were getting \$11,000 projects for \$3,000. But now Con Ed came back down to Earth, and so now I'm back down to like that 40% mark again.”

Contractors reported that financial incentives are also a key area for improving conversion rates in the future. Five contractors noted that adjusting the amount or structure of incentives could enhance customer interest in the program. As one contractor put it, “Having more dollars is helpful.” Specifically, they felt that increasing the heat pump incentive would significantly boost customer engagement. Several contractors believed that the heat pump incentive’s value, in relation to the installation cost, typically did not significantly motivate customers to install heat pumps. One contractor also suggested that adding incentives for other work necessary to prepare for heat pump installations—such as ductwork improvements or upgrading to Wi-Fi thermostats—could provide a valuable “little extra kicker for just the small stuff that people are kind of hesitant to buy because they don't really need it now.”

The team studied whether participation in Comfort Home has affected the time between initial customer contact and package installation. **Contractors reported that this timeline has remained relatively consistent since joining the program. On average, the duration across all eleven contractors was approximately 7.5 weeks, with times ranging from 3 weeks to about 20 weeks.** The mode for the timeframe was around 4 to 5 weeks. Interestingly, the three contractors with high project volumes and low QA/QC ratings took the longest to complete Comfort Home projects (Table 15). However, it is difficult to draw definitive conclusions due to the small sample size.

Table 15. Estimated Average Time to Complete Comfort Home Projects (Weeks)

Contractor Strata (n=11)	First contact to audit	Audit to signed contract	Signed contract to install	Total Time
High project volume & High QA/QC	1-2	N/A ^a	5-6	8-9
	2	2	2-3	4-5
	1.5-2	<1	3	4-5
High project volume & Low QA/QC	1-2	3	8	12
	2-3	4-6	3-6	12-15
	4	8	8	20
Low project volume & High QA/QC	1	2	2	8
	1	1.5-2	2	5
	1	1.5-2	2	5
Low project volume & Low QA/QC	1	1-2	1-2	3
	1	<1	2-3	4
Average (mean) time	1.7	2.4	3.7	7.6

^a This contractor explained that they have the customer sign the contract when they show up to do the work. There is no separate signing process in between the audit and installation.

3.2.5 Heat Pumps and Home Electrification

As noted above, a key objective of Comfort Home is to prepare homes to be “heat pump ready.” In the customer survey and contractor interviews, the evaluation team probed customers’ experiences with heat pumps, including comfort benefits, usage patterns, and issues after installation. The survey also explored factors influencing heat pump adoption and barriers to installation. Interestingly, although a minority of contractors promoted heat pumps to their customers, customers who did install a heat pump said the Comfort Home Program influenced their decision to get a heat pump. Environmental concerns were also a key motivator, and adoption was more common among higher-income households, those using delivered fuels, and those with solar PV—suggesting that certain household characteristics play a role in adoption decisions. In contrast, the main barriers to installing a heat pump were cost-related: high upfront costs and operating costs.

The team asked Comfort Home contractors if they discussed heat pumps with customers at the time of the Comfort Home upgrade, and why they may or may not discuss this with customers. **While six of the eleven contractors interviewed offered heat pump installation services, only one contractor indicated they discussed heat pump readiness as part of their general customer education for the program at the time of the audit. In contrast, more contractors said they discussed heat pumps after the customer signed the contract and they began the upgrade work:** three contractors reported that they rarely mentioned heat pumps, five said it depended on the situation, and three contractors stated they always discussed heat pumps with customers. Three contractors refrained from discussing heat pumps extensively, as they were concerned about overwhelming customers with additional costs.

Several factors influenced contractors' decisions about whether it was worthwhile to address heat pumps with customers:

- Home factors: Five contractors said that aspects of individual homes, like the age of existing equipment, fuel type, and home size, determined whether they thought it was worthwhile to discuss heat pumps with customers. Contractors said that discussing heat pumps was generally easier if customers were on oil or propane or had older systems that needed an upgrade soon.
- Homeowners’ goals and interest: Four contractors noted that if a customer expressed interest in heat pumps, electrification, or green energy, they were more likely to engage in discussions about heat pumps. One contractor explained,

“It’s kind of their frame of mind where they’re at and why they called. I mean, most of them are specifically calling for insulation, and they don’t want to hear a big spiel about other expenses. They just want to focus on the problem at hand...so I’m not necessarily introducing them to whole new other ideas and concepts.”

- Contractor offered heat pump services: Four contractors mentioned that they rarely discussed heat pumps or did not delve into the topic in much detail because their companies did not offer heat pump installation services. One contractor stated, “At the moment [I discuss heat pumps] very little ‘cause it’s not something that we offer.”

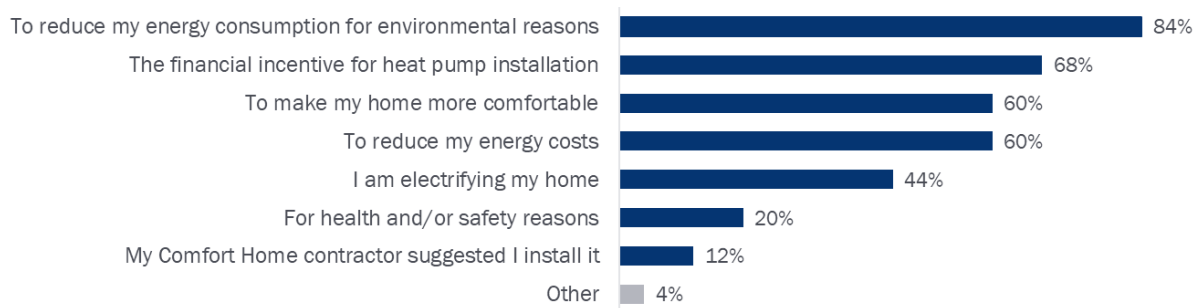
Contractors noted that customer reception of information about heat pumps varied due to the factors mentioned above, but a common theme was that many customers often felt overwhelmed by the potential costs associated with heat pumps. One contractor said, “We don’t really present that [heat pump information] during the insulation work because I don’t want them to be dissuaded or feel like they’re overwhelmed by doing heat pumps.” Another contractor shared a similar sentiment, saying,

“One of the fears with heat pumps is that sometimes if you create a project that's too big and nothing gets done. A heat pump itself is typically a very large purchase for a customer. For most people to wrap their head around insulating the whole house and doing the heat pump all at the same time, while from an energy perspective sure it's important and it works, but from a financial perspective, it doesn't.”

While contractors reported that they didn’t always discuss heat pumps with customers, the majority of survey respondents who installed a heat pump after Comfort Home indicated that Comfort Home influenced their decision. Of the twenty-five respondents who reported installing a heat pump in their home after receiving their Comfort Home upgrades, all but two (92%) said that Comfort Home was at least slightly influential in their decision to install a heat pump.

Most respondents who received a heat pump after Comfort Home (84%) reported that reducing energy consumption for environmental reasons was one of the main reasons they decided to install a heat pump (Figure 13). Although less than half of the respondents (44%) indicated that electrifying their homes was the main reason for installing a heat pump, contractors believed that home electrification was often at least a consideration—even if it wasn’t the primary motivation—for many people who ultimately chose to install a heat pump. Several contractors noted that customers who installed heat pumps were often interested in “getting off fossil fuels” or “focused on their carbon footprint.”

Figure 13. Survey Respondent Main Reasons for Installing a Heat Pump After Comfort Home Upgrades (n=25)



While the primary intent for the Comfort Home heat pump incentive is to incentivize contractors to discuss heat pumps with customers, 68% of survey respondents reported that heat pump financial incentives motivated them to install a heat pump. In the contractor interviews, four contractors emphasized that the availability and amount of rebates and incentives influenced customers’ decision to install a heat pump. One contractor described this as “the biggest driving factor,” and several noted that the Comfort Home incentive was insufficient to motivate many customers to make the switch. Contractors explained that the extent of available rebates varied by region, utility, and eligibility for income-based programs.

The survey and contractor interviews also highlighted that the type of heating fuel, presence of solar PV, and household income were all significantly associated with heat pump adoption after participating in Comfort Home. Three of the 11 interviewed contractors shared that customers using delivered fuels like propane or oil were much more inclined to switch to heat pumps to lower their utility bills. Nearly half (44%) of survey respondents who installed a heat pump after Comfort Home had previously used delivered fuels for heating, compared to just 14% of respondents who did not install a heat pump (significant at $p < 0.1$). One contractor stated that homes with electric, oil, or propane heating could reduce their bills by “almost half” with a heat pump. Another said,

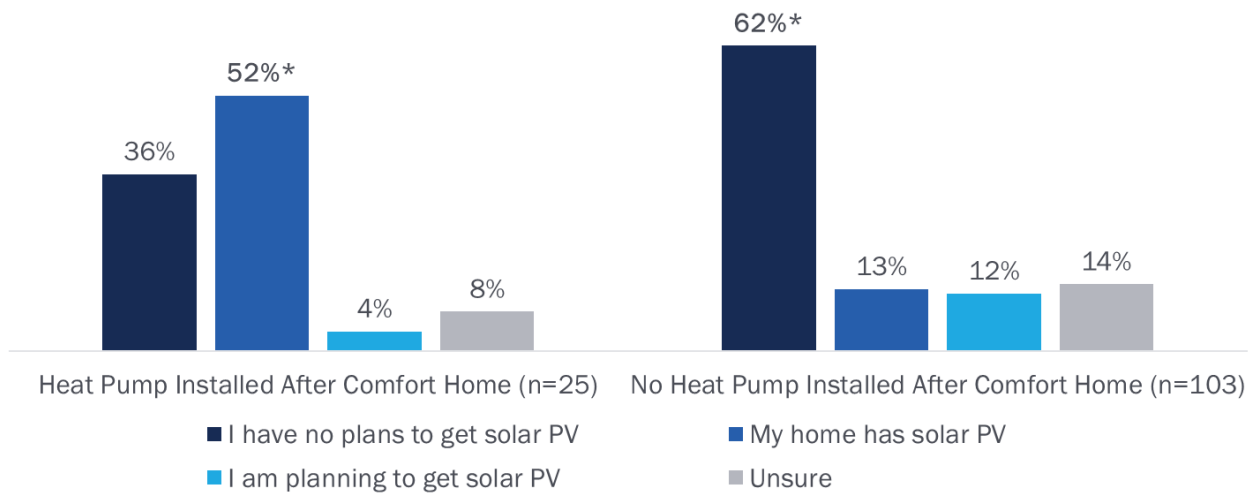
“There are more people with natural gas, so that one gets switched more. But I would say, if I was going by success rate, percentage-wise...delivered fuels, we have a higher success rate of switching to heat pumps than we do for natural gas.”

Respondents who installed a heat pump after Comfort Home were also significantly more likely to have solar PV than those who did not install a heat pump ($p < 0.1$, indicated by * in Figure 10). About half of respondents (52%) who installed a heat pump after Comfort Home had solar PV, while only 11% of respondents with no heat pump had solar PV (Figure 14). On the other hand, those who did not install a heat pump were significantly more likely to report having no plans to install solar PV, compared to

respondents who installed a heat pump after their Comfort Home upgrades ($p < 0.1$). While interviewed contractors reported that most of their customers did not already have solar, a few thought that there might be general interest in eventually installing solar among customers who installed heat pumps. One contractor said,

“Probably 5% of customers [getting a heat pump] have existing solar...but then the number of solar customers where we’re installing solar, I would say probably 80% of those customers have us install the heat pump if we’re installing the solar.”

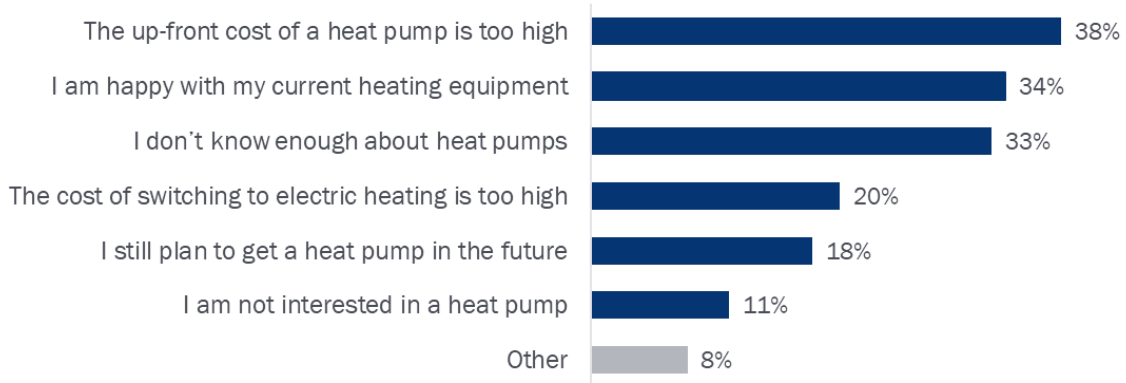
Figure 14. Plans to Install Solar PV Among Heat Pump Adopters and Non-Adopters



Finally, household income over \$200,000 was significantly associated with installing a heat pump after Comfort Home ($p < 0.1$). Almost half of respondents (44%) who installed a heat pump after Comfort Home reported 2023 household income over \$200,000, compared to only 16.5% of respondents who did not install a heat pump.

Survey respondents who did not go on to install a heat pump reported several reasons or barriers they decided not to do so, including upfront and operating cost, satisfaction with current equipment, and lack of knowledge about heat pumps (Figure 15).

Figure 15. Reasons for Not Installing Heat Pump After Comfort Home (n=89)



Both contractors and survey respondents identified the upfront cost as the main barrier to installing a heat pump. Five of the six contractors who offered heat pump installations noted that the cost of the equipment deterred many customers from considering a heat pump. One contractor stated, “A lot of folks just aren’t ready to invest that much money into their house.” The participant survey also found that the cost was the main barrier to installation, with over a third of respondents (34 of 89; 38%) reporting that upfront cost was a reason they did not install a heat pump after participating in Comfort Home.

In addition to the upfront cost, respondents were also wary of the operating costs associated with switching to electric heating. While only 20% (18 of 89) of survey respondents reported this was one of the main reasons they did not install a heat pump, several contractors noted that many customers were particularly sensitive to how their utility bills would change after switching to a heat pump. Some expressed concerns about possible increases in their electric bills, regardless of the potential reductions to their natural gas or delivered fuel bills. Additionally, contractors reported that many customers sought assurance that their overall expenses would decrease, but the contractors explained they were unable to provide definitive guarantees.

About a third (30 of 89; 34%) of survey respondents reported that satisfaction with current heating equipment was one of the main reasons they did not install a heat pump after Comfort Home. Similarly, three contractors mentioned that the age and condition of customers’ existing systems often played a significant role in their decision to switch to heat pumps. One contractor explained that some customers would first assess their home’s performance with the new Comfort Home upgrades during winter. If they continued to experience issues after the initial upgrades, they might consider upgrading to a heat pump.

Finally, three contractors mentioned that misconceptions about heat pump effectiveness influenced customers’ decisions to install a heat pump. They reported that some individuals believe “the stigma” that

heat pumps are unsuitable for the Northeast climate and don't heat homes adequately. One contractor added, "There's still a lot of people that are not educated enough to know that the heat pumps perform better than they did 10 years ago." In the customer survey, a third of respondents (29 of 89; 33%) who did not install a heat pump said that lack of knowledge about heat pumps was one of the reasons they did not install a heat pump.

Most survey respondents who installed heat pumps after their Comfort Home upgrades reported that additional work was completed as part of the installation process, such as electrical panel upgrades. Four of the six contractors that installed heat pumps said that customers required panel upgrades 50-75% of the time. These homes typically had panels that were less than 200 amps, which required upgrading to 200+ amps. Additionally, about two-thirds (60%) of survey respondents who received a heat pump after Comfort Home reported that they received a new thermostat when their heat pump was installed.

Most contractors reported that they fully decommissioned old heating equipment for more than 75% of their heat pump installations. Similarly, of the 25 Comfort Home survey respondents who installed a heat pump after the program, only four (16%) still had their old equipment installed as a backup system. Several contractors mentioned that they usually do this because it is often required to receive rebates. Only two contractors were aware of the switchover temperature set for homes where they did leave the backup system. One contractor said the switchover temperature was 15°F, and another said they program the switchover for 30° F. The latter contractor's rationale appears to reflect experience with older heat pump technology, as new cold-climate air source heat pumps are designed to operate efficiently well below 30° F when properly sized. This contractor explained,

"30°F and warmer are when heat pumps are always the most efficient...and half of your heating degree days a year are 30°F or warmer, so we cut the carbon emissions for the house by half on the heating side just by putting the heat pump down to 30...So it's still a win as far as carbon emissions."

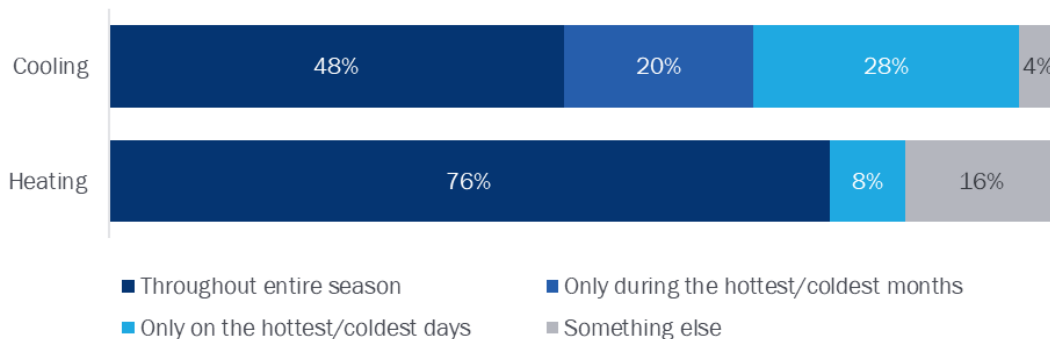
Most thermostat temperature set points did not show significant changes before and after Comfort Home participation among survey respondents who installed a heat pump, but winter temperature set points for times away from home did show a statistically significant increase ($p < 0.1$) after the program (Table 16). The results suggest a moderate effect of Comfort Home participation, leading to a mild increase in winter temperature set points for times away from home (Cohen's $d = 0.534$).

Table 16. Temperature Set Points Before and After Comfort Home Participation and Heat Pump Installation

Condition	Before Comfort Home		After Comfort Home	
	n	Mean Temperature	n	Mean Temperature
Summer At Home	15	72.0	24	71.9
Summer Away from Home	12	75.0	17	75.4
Winter At Home	22	68.7	25	69.0
Winter Away from Home	21	62.1	23	63.7

In addition to temperature set points, the survey asked participants who installed a heat pump to describe how they used their heat pump for heating and cooling. **The majority of respondents (76%) who received a heat pump after Comfort Home reported that they used their heat pump for heating throughout the entire heating season from October to May (Figure 16).** Nearly half (48%) reported using their heat pumps throughout the entire cooling system from May to September, with 28% reporting they only used their heat pumps on the hottest days and 20% reporting they only used it in the hottest months from June to August. Four (16%) respondents indicated that they used their heat pumps to supplement their current systems, with one saying, “It is used to supplement the propane boiler,” and another sharing, “I am in the middle of converting to heat pumps...they are not enough to heat the entire house yet and I still depend on the old natural gas system. I currently run the two in a mixed way.”

Figure 16. Use of Heat Pump for Heating and Cooling (n=25)



3.2.5.1 Outcomes for Heat Pump Adopters

The evaluation team queried contractors and survey respondents about several outcomes for customers who installed heat pumps, including changes in energy use, satisfaction with the equipment, and issues experienced.

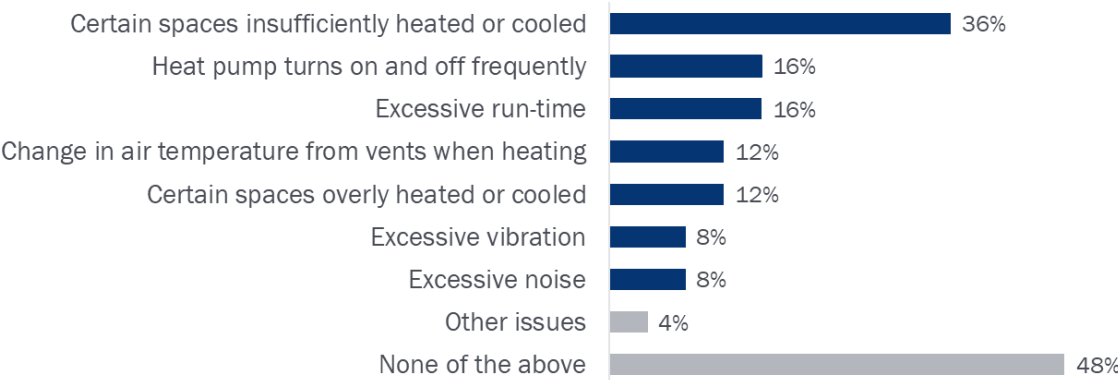
Generally, survey respondents who installed a heat pump after Comfort Home seemed satisfied with their outcomes, with 72% reporting they would be very likely to recommend a heat pump to others (Figure 17).

Figure 17. Likelihood to Recommend Heat Pump to Others (n=25)



Nearly half (48%) of respondents who installed a heat pump after Comfort Home reported that they did not experience any of the issues listed as options in the survey (Figure 18). The most common reported issues were that certain spaces were insufficiently heated or cooled (36%), the heat pump turning on and off frequently (16%), and excessive run time (16%). Contractors reported they had some challenges with heat pump supply chains, but they did not report any other issues unique to heat pump installations.

Figure 18. Issues Experienced Related to Heat Pump Installed After Comfort Home (n=25)



3.2.6 Conclusions and Recommendations

3. **During the evaluation period, the Comfort Home Program achieved total first year energy savings of 20,660 MMBtu including natural gas and electric.**^{xvi} Natural gas savings account for approximately 95% of these electric and natural gas program savings. These results represent deep energy savings and reduced baseline heating consumption by up to 20%, depending on which program package was chosen. Across all fuels, natural gas represents 68% of all savings; ongoing evaluation studies will capture the impact related to the remaining delivered fuels population.

- a. **Recommendation:** Revisit the program’s incentive structure to ensure incentives are aligned with the energy savings potential of measures. In particular, incremental incentives for installing windows in Package C may be misaligned with their savings potential.

NYSERDA Response to Recommendation: Implemented. Package C has been renamed to “Windows Add-on” and the available incentive has been reduced to a lower value than the other two Package offerings.

- b. **Recommendation:** To facilitate access to the necessary data required for future impact evaluations, NYSERDA should continue to enforce the requirement that contractors collect and submit consent forms. The evaluation team understands that NYSERDA’s efforts with recent Comfort Home projects have a high consent form compliance rate (95% in 2024). Use a consistent file naming format (such as Last name <Space> First name) to make it easier to locate already collected consent forms.

NYSERDA Response to Recommendation: Pending. NYSERDA will consider implementing a required file naming convention for contractors uploading customer consent forms.

4. **The realization rate of natural gas savings was 66%, indicating room for improvement in the accuracy of program-estimated savings.**^{xvii} Sub-group analysis suggests the program energy savings modeling algorithms are more reliable for inefficient homes and tend to overstate savings for more efficient homes. [make note here or in an end note about not applying electric RR]

- a. **Recommendation:** Review and improve program algorithms to enhance program-estimated savings estimates for more efficient homes.^{xviii}

NYSERDA Response to Recommendation: Implemented. NYSERDA has transitioned from the NY Technical Resource Manual Custom Measure Category 5 to Custom Measure Category 6 to model estimated savings. This updated savings methodology requires more inputs and is expected to result in more accurate energy savings predictions.

4. **The Process Evaluation revealed that Comfort Home contractors were highly satisfied with the Comfort Home program’s simplicity, including its streamlined processes, minimal paperwork, and user-friendly workflow platform.** While these aspects currently set it apart from other incentive programs, contractors expressed concern that upcoming changes to workflows would introduce inefficiencies to the processes and undermine the strengths of the program. Additionally, while contractors receive initial onboarding training, there was a lack of ongoing training, particularly on customer education. This results in wide variability in how heat pumps are presented, potentially leading to missed opportunities for customer education and heat pump adoption.

- b. **Recommendation:** Maintain the program’s streamlined workflow and minimal paperwork requirements. If changes are needed, gather contractor input and provide clear training and support to avoid added complexity or confusion.

NYSERDA Response to Recommendation: Implemented. NYSERDA intends to maintain Comfort Home’s streamlined processes.

- c. **Recommendation:** NYSERDA, in coordination with NYS Clean Heat and other stakeholders, should determine what, if any, heat pump communication should take place through Comfort Home. If contractors will be expected to deliver or support heat pump messaging, materials and training should be made available. This could include creating or leveraging existing training modules on the long-term benefits of heat pumps and customer engagement strategies or leave-behind materials contractors can give to customers after the upgrades are complete.

NYSERDA Response to Recommendation: Pending. NYSERDA will consider the extent of heat pump communication Comfort Home contractors will be expected to provide to customers in line with broader electrification efforts statewide.

5. **Most customers who participated in Comfort Home reported improved home comfort and lower energy bills, particularly among those who installed heat pumps.** Adoption of heat pumps was driven largely by environmental motivations and was more common among higher-income households, those using delivered fuels, or those with solar PV. However, the high upfront cost remains a barrier for many, especially middle-income households who may not qualify for low-income support but still find current heat pump incentives inadequate.

b. **Recommendation:** Provide learnings and recommendations to NYS Clean Heat program administrators as well as NYS Joint Utility program administrators who are designing regional market-rate weatherization programs to enhance incentives for households earning under \$200,000. Even if heat pump incentives fall outside of Comfort Home’s future program structure, learnings from the program could inform the design of more effective incentive structures and support improved heat pump affordability and adoption.

NYSERDA Response to Recommendation: Implemented. NYSERDA is providing learnings and recommendations to NYS Clean Heat program administrators and NYS Joint Utilities market-rate weatherization programs

Appendix A: Additional Consumption Analysis Details

This appendix provides additional details on consumption analysis data preparation, methodology, and results.

A.1 Participation Data

The evaluation team received program-tracking data for 1,939 participants who installed one of the three program packages between March 12, 2020, and April 30, 2023. The participant dataset contained a range of data fields, including identifiers, participation dates, installed measures, and housing characteristics, among others. In consultation with the NYSERDA team, the evaluation team selected the date field *Project Status Install* to categorize billing periods into pre- or post-intervention periods.

The Comfort Home Program provides building shell measures that reduce heating and cooling energy use. The evaluation team used data in *Stages - Primary Heating Fuel* and fuel-specific program reported savings values to categorize participants into those with natural gas heating (68.5%), delivered fuel heating (24.2%), and electric heating (7.3%; see Table A- 1).¹¹

Table A- 1. Distribution of Primary Heating Fuels

Primary Heating Fuel	Number of Participants	Share of Total
Natural Gas Heating	1,328	68.5%
Delivered Fuel Heating	469	24.2%
Electric Heating	142	7.3%
Total Heating	1,939	100%

A.2 Consumption Data

A.2.1 Consumption data request

During measure installation, Comfort Home contractors collect customer consent forms, which include (i) natural gas and electricity utility serving the home (including utility name and account number), (ii)

¹¹ The data field *Stages - Primary Cooling Type* can identify participants with central electric cooling systems. However, some participants may have other types of electric cooling equipment (e.g., window units or portable ACs) not captured in the tracking data. To ensure all cooling impacts are included, average electric cooling savings were estimated across all participants, rather than limited to those with reported central electric cooling.

delivered fuel type and supplier, and (iii) the participant’s consent to release their energy consumption data to NYSERDA or a third-party appointed by NYSERDA. Completion of the consent form is not mandatory, but utility data can only be requested for customers who have signed a consent form.

NYSERDA provided available consent forms to the evaluation team. The evaluation team reviewed these forms, organized them by utility, and identified participants to include in the utility data request. Table A-2 shows the number of accounts for which utility data were requested and the number of accounts for which utility data were received. In all, the evaluation team requested data for 875 natural gas accounts and 1,201 electric accounts. The evaluation team received data for 715 natural gas accounts and 998 electric accounts, which represent 54% of participants with primary natural gas heat and 52% of all participants (all participants have electric service).

Table A- 2. Consumption Data Requested and Received

Utility	Natural Gas		Electricity	
	Num. of Accounts Requested	Num. of Accounts Received	Num. of Accounts Requested	Num. of Accounts Received
National Grid	380	358	481	471
NYSEG	32	29	138	134
RGE	58	54	66	63
Central Hudson	11	6	23	20
ConEd	267	229	381	310
National Fuel	40	39	-	-
Orange & Rockland	87	Data not received	112	Data not received
Total	875	715	1,201	998

A.2.2 Billing data preparation

The team investigated the utility consumption data for the following issues:

- Explored instances of **duplicate records** and removed exact and partial duplicate records.
- Explored the extent of **missing data** (including missing date, consumption values, and reading type) and removed them as appropriate.
- Removed customers with an **average consumption of zero** during the whole sample period.
- For participants with bi-monthly billing data, two additional steps were applied to ensure data quality: Removed **records with missing rate type** values and confirmed that the first observation for each customer was based on an actual meter reading.

- Removed records with **overlapping bill periods**.
- Addressed **estimated readings** for NYSEG, RGE, and ConEd. For these utilities, estimated readings alternated with actual readings. Since estimated readings might cause issues in modeling, each estimated reading was combined with the next actual reading.¹²
- Removed records with **atypical billing periods**, defined as billing periods longer than 90 days, and combined short billing periods of 10 days or less with the next billing period.
- Flagged, examined, and removed **negative consumption values**.
- Identified **extreme consumption values** in the consumption data and removed observations within the top 1% of monthly consumption values for the electric billing data only. For the natural gas data cleaning, customers whose average monthly consumption was in the top 1% and bottom 1% were removed. This process included a manual review of a selected sample of accounts with the highest occurrence of outliers to determine which specific outliers or accounts needed to be removed.
- Excluded customers with **extreme changes in consumption**, defined as consumption that changed by at least 50% from the 12 months prior to intervention to the 12 months after intervention.
- Dropped all accounts with **insufficient billing history**, defined as less than 66% observations of coverage preceding or following the intervention, as well as summer and winter sufficiency.
- Removed participating accounts that **did not merge with the consumption data**.
- Removed natural gas accounts that showed **very low or no heating use preceding the intervention**, defined as a negative heating slope for the site-specific regression, heating dependent use less than the base non-heating dependent use, or winter bills (>150 HDD) with zero natural gas consumption.

After completing these steps, the final number of participants available for modeling was 411 for the natural gas analysis (31% of all participants with natural gas heating and 57% of the participants with natural gas billing data received from the utilities). In electric analysis, 563 accounts were retained (29% of all participants and 56% of all participants with electric billing data received from the utilities), including 30 participants with primary electric heat.

¹² In the natural gas data cleaning the ConEd data had a number of sites where the data was listed as estimated reads for over a year of data. These sites were carefully reviewed as they did not show the pattern of typical bi-monthly reads. They were included in the final model and the R-squared is within the expected range, suggesting that these reads may have been erroneously marked as estimated.

The following tables summarize the extent of account drops during each billing data cleaning step. As shown, most account drops across all utilities are due to insufficient pre-period and post-period consumption data. After completing the data cleaning for all utilities, the evaluation team retained the following percentages of participants: 65% for Central Hudson, 73% for National Grid, 30% for ConEd, 52% for RGE, and 60% for NYSEG accounts. Overall, the evaluation team retained 56% of all customers who provided consent forms across all utilities.

Table A- 3. Data Cleaning Drops Table: Electric

Drop Reason	Accounts Dropped (N)	Accounts remaining	
		N	Percentage (%)
Original Counts of Participating Sites		998	100%
Exact Duplicates	0	998	100%
Exact Duplicates by Bill Period	0	998	100%
Missing or Infinite Consumption Values	0	998	100%
Average Consumption is Zero	0	998	100%
Long Bills (>90 days)	3	995	100%
Combining Short Bills (< 10 days)	0	995	100%
Negative ADC	0	995	100%
Overall Customer with Extreme ADC Values	11	984	99%
Bill ADC Outliers	0	984	99%
Overlapping Bills	0	984	99%
Data Sufficiency Drops	371	613	61%
Customers With a Consumption Change of 50% or More From Pre to Post Periods	50	563	56%

Table A- 4. Data Cleaning Drops Table: Natural Gas

Drop Reason	Accounts Dropped (N)	Accounts remaining	
		N	Percentage (%)
Natural Gas Homes with Bills Received		715	100%
No Program-Estimated Natural Gas Savings	70	645	90%
Overlapping Bills	19	626	88%
Negative Reads	7	619	87%
Combining Short Bills (< 10 days)	0	619	87%
Long Bills (>90 days)	65	554	77%
Data Sufficiency Drops	96	458	64%
Overall Customer with Extreme ADC Values	5	453	63%
Customers With a Consumption Change of 50% or More From Pre to Post Periods	5	448	63%
Customers with Heating Use Problems	37	411	57%

A.2.3 Weather Data

To account for weather patterns in the energy consumption models, the evaluation team used “actual” weather data, i.e., location hour-specific temperature observations, from 20 weather stations across New York State, utilizing the site closest to each account’s geographic location. Using multiple sites increases the accuracy of the weather data associated with each account. The evaluation team obtained this data from the National Climatic Data Center (NCDC). The daily data are based on average hourly temperature readings for each day. The evaluation team calculated CDD and HDD for each day, then aggregated them up to the monthly level, and used the number of days in the billing period to estimate average daily CDD and HDD.¹³ Then, the evaluation team merged daily weather data into the consumption dataset.

To calculate weather-normalized savings, the evaluation team used TMYx “typical” weather data, based on the same weather stations selected for the actual weather data, and used the same approach to calculate the CDD and HDD for each day.

¹³ A “degree-day” is a unit of measure for recording how hot or how cold it has been over a 24-hour period. The number of degree-days applied to any particular day of the week is determined by calculating the mean temperature for the day and then comparing the mean temperature to a base value of 60°F for space heating (HDD) and 70°F (CDD) for space cooling. (The “mean” temperature is calculated by adding together the high for the day and the low for the day, and then dividing the result by two.) If the mean temperature for the day is five degrees higher than 70°F, then there have been five cooling degree-days. On the other hand, if the weather has been cool, and the mean temperature is, say, 55°F, then there have been 10 heating degree-days (60 minus 55). “Degree Days,” National Weather Service, <https://www.weather.gov/ffc/degdays>.

A.3. Model Specifications and Results

Homes use natural gas and electricity for different applications, resulting in different consumption patterns. For homes with natural gas heating, nearly all natural gas consumption is dedicated to heating. Conversely, electricity serves multiple purposes. Moreover, natural gas and electricity observations are obtained from different data streams and are in different units. Therefore, the evaluation team calculated natural gas and electricity savings independently

A.3.1 Model Specifications and Results

The evaluation team specified multiple linear fixed effects D-in-D models to estimate energy savings in the Comfort Home Program. This is the industry-standard specification for estimating energy savings for efficiency programs where the start of treatment varies between participants.¹⁴ Savings were weather-normalized using TMYx data.

A.3.1.1 Natural Gas Consumption Modeling

The evaluation team first specified a model controlling customer-specific and time-period effects while accounting for weather variation using average cooling and heating degree days. Equation 1 presents the regression equation.

Equation 2. Model 1 Specification

$$Therm_{it} = \gamma_{im} + \beta_1 Treat_{1,it} + \beta_{HDD} HDD_{it} + \beta_{Treat-HDD} HDD_{it} Treat_{1,it} + \varepsilon_{it}$$

Where:

$Therm_{it}$ = Average daily consumption for account i in month-year t , (therms)

γ_i = Account-specific intercept for account i

$Treat_{1,it}$ = Indicator variable for the program treatment (0 before the installation of measures, 1 after the installation)

HDD_{it} = Average daily heating degree days for account i at month-year t

β_1 = change in base (non-weather-dependent) use between the pre and post periods (therms/day)

β_{HDD} = heating slope throughout the pre- and post-periods (therms/HDD); the heating slope is the change in natural gas consumption for each HDD

$\beta_{Treat-HDD}$ = change in heating slope between the pre- and post-periods (therms/HDD)

ε_{it} = Error term

¹⁴ Agnew, K.; Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68564. <http://www.nrel.gov/docs/fy17osti/68564.pdf>

The results are shown in Table A- 5. The model achieved a strong fit with an adjusted R-squared of 0.795. The energy savings are statistically significant at the 99% confidence level.

Table A- 5. Natural Gas Model 1 Results

Estimator	Coefficients
Intercept	0.583 Therms/day***
HDD	0.182 Therms/HDD***
Treat	-0.066 Therms/day*
Treat * HDD	-.0268 Therms/HDD***
Observations	9,820
Adjusted R-Squared	0.795

* p<0.1, ** p<0.05, *** p<0.01.

Two other models were tested:

1. Adding time variables to account for widespread changes in natural gas use over time
2. Adding the Comfort Home packages to assess whether savings varied by package

In selecting the final model, the evaluation team considered the following factors:

- Does the model improve the precision of the savings?
- Which model has the best fit?
- How stable are the savings?

The model with the best fit may not always result in more stable or accurate savings. If the test model's results in similar savings, it provides more certainty that the results are reliable. Adding time variables to address widespread changes in consumption over time is difficult in natural gas models, as these variables absorb some of the seasonal and weather-dependent effects. A common approach is to add an indicator variable for each year. This approach was tested with the following results: the R-squared was the same, and the resulting savings from the model with the year variables were within 2% of the savings from Model 1. The evaluation team concluded that adding the year variables had little impact on the final results in the case of natural gas analysis.¹⁵

The package model added indicator variables to estimate the savings from Packages A (Good), B (Better), and C (Best). The configuration is shown in Equation 2.

¹⁵ Model 2 specification and results are available upon request.

Equation 3. Model 3 (Package) Specification

$$\begin{aligned}
 Therm_{it} = & \gamma_{im} + \beta_1 Treat_{1,it} + \beta_{HDD,1} HDD_{it} + \sum_{j=2}^J \beta_{HDD,j} HDD_{it} P_j + \beta_{Treat-HDD,1} HDD_{it} \\
 & + \sum_{j=2}^J \beta_{Treat-HDD,j} HDD_{it} P_j Treat_{1,it} + \varepsilon_{it}
 \end{aligned}$$

Where:

$\beta_{HDD,1}$ = baseline heating slope for Package A (therms/HDD)

$\beta_{HDD,j}$ = baseline heating slope throughout the analysis period for Package j as compared to the heating slope for Package A (therms/HDD)

$\beta_{Treat-HDD,1}$ = change in heating slope between the pre- and post-periods for Package 1

$\beta_{Treat-HDD,j}$ = additional change in heating slope between the pre- and post-periods for Package j as compared to Package A

j = Package counter, from A to C

P_j = indicator variable for the Package (1 if the home installed Package j , otherwise 0)

Other variables are defined above.

Results of the package model are presented in Table A- 6. The R-squared for the package model is higher than the original model, .813 as compared to 0.795. The post-period change in heating slope for Package 1 is statistically significant at the 99% confidence level, as is the additional change in post-period heating slope between Packages 1 and 3. The additional change for Package 2 as compared to Package 1 is statistically significant at the 85% confidence level.

Table A- 6. Natural Gas Model 3 Results

Estimator	Coefficients
Intercept	0.576 Therms/day***
HDD	0.211 Therms/HDD***
HDD ₂	-0.0429 Therms/HDD***
HDD ₃	-0.0761 Therms/HDD***
Treat	-0.063 Therms/day*
Treat-HDD	-0.0293 Therms/HDD***
Treat-HDD ₂	-0.0045 Therms/HDD
Treat-HDD ₃	0.0186 Therms/HDD***
Observations	9,820
Adjusted R-Squared	0.813

* p<0.1, ** p<0.05, *** p<0.01.

The package model was selected over the original model because the R-squared is higher, average savings are almost identical to the model, the relative precision for the program savings is more precise, and the package model provides key information about the program performance.

The final model was reviewed for violations of the generalized linear least squares assumptions. The most common violations are heteroskedasticity (unequal variances) and autocorrelation.

- Heteroskedasticity is common in billing models due to the variation in consumption patterns among households and may result in high variances, although the estimators should be unbiased. The Goldfeld-Quandt test was conducted, resulting in a GQ test statistic of 4.31, which is higher than the cutoff of 1.0. However, from previous experience with these models, the evaluation team has found that 4.3 is on the very low end of results from similar natural gas consumption models. Thus, heteroskedasticity is not considered a concern for this analysis.
- Autocorrelation occurs when one observation is related to the previous one, as occurs with residential billing, as the current bill is likely to be similar in magnitude to the prior bill. Autocorrelation does not introduce bias to the estimators but does decrease the variance. The pooled Durbin-Watson test statistic was 2.4, where a value of 2.0 indicates no autocorrelation and a value of 2.5 or higher suggests that there may be a serious issue with autocorrelation. Thus, autocorrelation is not considered an issue in this analysis.

A.3.1.2 Electricity Consumption Modeling

The evaluation team specified multiple linear two-way fixed effects D-in-D models to estimate weather-normalized electric savings for the Comfort Home Program.¹⁶ Given the rolling enrollment of the Comfort Home Program, participants who are yet-to-be-treated serve as a natural comparison group. Additionally, in the electric model, the evaluation team curtailed modeling data to March 2023 so that the April 2023 participants serve as the “never-treated” group in an attempt to ensure that there is a set of never-treated participants in the model.¹⁷ This is necessary in the electric model, given the greater end use and variability in electric consumption. Thus, the models compare treated participants to yet-to-be-treated and never-treated participants during the evaluation while controlling for weather, differences in average consumption between participants (using participant fixed effects), and differences in average consumption over time unrelated to weather (using month-year fixed effects).

The evaluation team first specified a model controlling customer-specific and time-period effects while accounting for weather variation using average cooling and heating degree days. Equation 4 presents the estimated equation.

Equation 4. Model 1 Specification

$$kWh_{it} = \gamma_{im} + \tau_t + \beta_1 Treat_{1,it} + \beta_{CDD} CDD_{it} + \beta_{HDD} HDD_{it} + \varepsilon_{it}$$

Where:

kWh_{it} = Average daily consumption for account i in month-year t

γ_i = Account-specific intercept for account i

τ_t = Month-year-specific intercept for t

$Treat_{1,it}$ = Indicator variable for the first participation year period (coded “1” in the participation period, coded “0” otherwise)

CDD_{it} = Average daily cooling degree days for account i at month-year t

HDD_{it} = Average daily heating degree days for account i at month-year t

β_1 = Change in base (non-weather-dependent) use between the pre and post periods (kWh/day)

β_{CDD} = Cooling slope throughout the pre and post periods (kWh/CDD); the cooling slope is the change in electricity consumption for each CDD

β_{HDD} = Heating slope throughout the pre and post periods (kWh/HDD); the heating slope is the change in electricity consumption for each HDD

ε_{it} = Error term

¹⁶ This is the industry-standard specification for estimating energy savings for efficiency programs where the start of treatment varies between participants.

¹⁷ Brantly Callaway, Pedro H.C. Sant’Anna, Difference-in-Differences with multiple time periods, *Journal of Econometrics*, Volume 225, Issue 2, 2021, Pages 200-230, ISSN 0304-4076, <https://doi.org/10.1016/j.jeconom.2020.12.001>.

The model achieved a strong fit with an adjusted R-squared of 0.65, indicating that the model explained a substantial portion of the variation in average daily consumption. However, the results showed savings that were not statistically significant, suggesting no detectable overall program impact on electric consumption. As expected, CDD was strongly and statistically significantly associated with increased consumption. However, HDD had a positive but statistically insignificant effect. These findings indicate that while the model is well-specified, the overall treatment effect was not statistically distinguishable from zero when both cooling and heating savings are considered.

Table A- 7. Model 1 Results

Variable	Coefficients
Treat	0.21 kWh/day
CDD	1.64 kWh/CDD ***
HDD	0.05 kWh/HDD
Observations (Number of Customer Bills)	20,931
Adjusted R-Squared	0.65

* p<0.1, ** p<0.05, *** p<0.01.

To better isolate the program's weather-dependent effects, the evaluation team then specified a model that interacted the CDD and HDD variables with the treatment term. This approach allowed us to estimate how consumption varied under actual heating and cooling conditions rather than averaging impacts across all months. Equation 5 presents the estimated equation.

Equation 5. Model 2 Specification

$$kWh_{it} = \gamma_{im} + \tau_t + \beta_1 Treat_{1,it} + \beta_{Treat-CDD} Treat_{1,it} * CDD_{it} + \beta_{Treat-HDD} Treat_{1,it} * HDD_{it} + \beta_{CDD} CDD_{it} + \beta_{HDD} HDD_{it} + \varepsilon_{it}$$

Where:

$\beta_{Treat-CDD}$ = Change in the cooling slope between the pre- and post-periods (kWh/CDD)

$\beta_{Treat-HDD}$ = Change in the heating slope between the pre- and post-periods (kWh/HDD)

Other variables are defined above.

The model achieved a strong fit with an adjusted R-squared of 0.65. Because the treatment effect is conditional on weather, the overall program impact during heating or cooling periods must be calculated as a linear combination of the relevant coefficients (i.e., treatment term plus the weather interaction terms). To determine whether the combined impact is statistically significant, the evaluation team used the variance-covariance matrix, which accounts for the uncertainty in each individual estimate and how

the estimates relate to one another. This allowed us to compute a standard error for the total effect and test its significance.

Model results showed a statistically significant positive relationship between CDD and energy use, and a similar but not statistically significant relationship with HDD. The treatment interaction with CDD was negative, indicating a potential reduction in consumption during cooling periods, though this result was not statistically significant. Conversely, the interaction with HDD was positive but also insignificant, suggesting a potential increase in consumption during heating periods. Overall, the model confirms that weather is a strong driver of consumption. While program impacts appear in the expected direction, they are not statistically distinguishable, given the sample size and variability.

Table A- 8. Model 2 Results

Variable	Coefficients
Treat	-0.29 kWh/day
Treat * CDD	-0.22 kWh/day/CDD
Treat * HDD	0.06 kWh/day/HDD
CDD	1.71 kWh/CDD***
HDD	0.05 kWh/HDD
Observations (Number of Customer Bills)	20,931
Adjusted R-Squared	0.65

* p<0.1, ** p<0.05, *** p<0.01.

The evaluation team specified a final model that added interaction terms between weather variables and home HVAC system type and heating fuel to further refine the estimation of weather-dependent program impacts. Specifically, this model allows the relationship between energy use and weather to vary for homes with central air conditioning (CAC)¹⁸ and electric heating (EH), acknowledging that program impacts may differ depending on cooling system type and heating fuel. Equation 6 presents the estimated equation.

¹⁸ The data field Stages - Primary Cooling Type is used to identify participants with central electric conditions systems. Approximately 65% of participants had central air conditioning systems.

Equation 6. Model 3 Specification

$$kWh_{it} = \gamma_{im} + \tau_t + \beta_1 Treat_{1,it} + \beta_{Treat-CDD} Treat_{1,it} * CDD_{it} + \beta_{Treat-HDD} Treat_{1,it} * HDD_{it} + \beta_{CDD} CDD_{it} + \beta_{HDD} HDD_{it} + \beta_{CDD-CAC} CDD_{it} * CAC_i + \beta_{HDD-EH} HDD_{it} * HE_i + \varepsilon_{it}$$

Where:

CAC_i = Indicator variable for the primary cooling type (coded “1” if customer has a central air conditioning as their primary cooling type, coded “0” otherwise)

EH_i = Indicator variable for the primary heating fuel (coded “1” if customer uses electricity as their primary heating fuel, coded “0” otherwise)

$\beta_{CDD-CAC}$ = Additional change in the cooling (kWh/CDD) for homes with CAC, relative to homes without CAC.

β_{HDD-EH} = Additional change in the heating (kWh/HDD) for homes with EH, relative to homes without EH.

Other variables are defined above.

Coefficients of the estimated model are presented in Table 9. This final model had a similar fit with an adjusted R-squared of 0.66. The results from this model indicate a statistically significant reduction in electricity consumption during cooling periods for program participants. The interaction between treatment and CDD was negative and statistically significant, suggesting the program had a measurable cooling-related impact. Meanwhile, the interaction between post-treatment and HDD remained positive but not statistically significant, implying limited evidence of a heating-related impact. Overall, this model supports the conclusion that program-driven cooling savings are present.

Table A- 9. Model 3 Results

Variable	Coefficients
Treat	-0.10 kWh/day
Treat * CDD	-0.35 kWh/day/CDD *
Treat * HDD	0.04 kWh/day/HDD
CDD	0.68 kWh/CDD***
HDD	0.04 kWh/HDD
CDD * CAC	1.70 kWh/CDD***
HDD * EH	0.58 kWh/HDD***
Observations (Number of Customer Bills)	20,931
Adjusted R-Squared	0.66

* p<0.1, ** p<0.05, *** p<0.01.

The evaluated savings are weather normalized by applying the estimated weather and treatment interaction coefficients to the typical weather (TMYx) data.